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Otitic Meningitis ... *James B. McBean*
Surgical Approach to the Pyriform Sinus ... *Norman Jesberg*
Congenital Bilateral Choanal Atresia ... *Arthur J. Crotzoaner and Meyrill Goodman*
Laryngotracheobronchial Papillomatosis of Children ... *J. H. Font*
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Improvement of Hearing in Otosclerosis by Means of Stapes-Mobilization Operation ... *David Myers and Bernard J. Ross*
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An Audiologic and Otorhinologic Study of Cleft-Lip and Cleft-Palate Cases ... *Maurice M. Halfond and John J. Ballenger*
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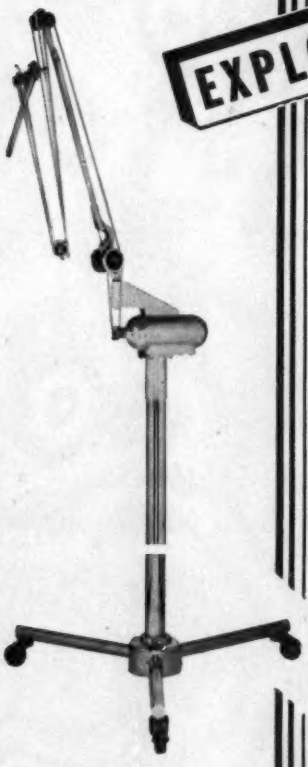

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TO OUR SUBSCRIBERS AND CONTRIBUTORS

SUBSCRIBERS and contributors to this journal have undoubtedly noticed some deviation from our usual publishing quality in the July and August and September issues. In particular, authors have had to correct very bad proofs in less than adequate time for careful reading. Subscribers must have detected an unusual number of typographical errors which were not corrected from the galleys. A most disturbing fact was the late mailing of these issues. Many of our authors and readers were quick to realize that such a departure from our usual standards could be due only to abnormal conditions, and we feel that these conditions need to be explained.

On April 23, 1956, the American Medical Association concluded negotiations for a contract with the Baird-Ward Printing Company, Inc., Nashville, Tenn., to print the American Medical Association Specialty Journals. Under the terms of the contract, the Baird-Ward Printing Company, Inc., was to begin with the July issues.

A transfer of a printing operation requires that many details be considered and many adjustments be made. A contract as large as this involved expanding a work force with skilled operators, not always readily available; installing additional machinery and type equipment not obtainable on short notice, and scheduling nine journals so as to coordinate their production with other jobs in the plant. Editorially, it meant increased pressure upon editors to meet an advanced schedule, the development of a common interpretation of editing procedures between typesetter and manuscript editor, and the working out of communications between the Editorial Office, printing plant, authors, and readers.

All this was a Herculean task in view of the short period of time allowed for the transfer. Obviously, substandard results could not be avoided. While a contributor or a reader is justly concerned with his individual article or copy, it is hoped that the realization of the many ramifications of the transfer will soften criticism of the initial effort, performed under an entirely new set of production conditions.

Many of the early problems have been eliminated. Others are being solved daily. The efforts of the editorial and manufacturing staffs are directed toward an improvement over what our readers have been offered in the past. Publication dates will be improved, and plans are progressing to make our subject contribution more essential to the profession.

We trust that a better understanding of the circumstances will enlist your patient indulgence in our efforts to return to normal publishing conditions and to keep a promise of a better product.

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A.M.A. Archives OF
OTOLARYNGOLOGY

Otitic Meningitis

A Review of Cases in an Attempt to Evaluate the Results of Treatment

JAMES B. McBEAN, M.D., Rochester, Minn.

Meningitis complicating otitis media is not common. Prior to the antibiotic and sulfonamide era, practically all patients with diffuse leptomeningitis, excluding meningococcus meningitis, died. Since the advent of antibiotic and chemotherapeutic agents, many patients recover; but the mortality rate is still high enough to warrant a review of such cases in an attempt to evaluate the results of treatment. In the 10-year period 1946 through 1955, fifteen patients with otitic meningitis were treated at the Mayo Clinic. Those patients with chronic otitis media and a history of meningitis in the past are not included in this study. Only those who were admitted with meningitis as a complication of otitis media are reviewed. The essential facts are recorded in the Table.

The 15 patients were seen with fairly uniform frequency, at a rate of 1 to 3 cases annually. There were 12 males and 3 females in the series. It is difficult to attach any significance to this sex difference. In the entire group there were six deaths and nine recoveries, an over-all mortality rate of 40%. However, none of the deaths occurred in cases of meningitis with chronic otitis media. Five deaths occurred in cases of meningitis with acute otitis media, and one death occurred in a case in which it was not determined whether the otitis was acute or chronic. The latter case will be discussed separately later. In the remaining 14 cases, there were 8 cases of acute otitis media and 6 cases of chronic otitis media, all with complicating meningitis. The ages of patients in the entire series ranged from 4 months to 58 years. The average age of those with acute otitis was 15.1 years, and the average age of those with chronic otitis was 39.2 years. In the group of eight patients with acute otitis and meningitis, there were five deaths, a mortality rate of 62%.

The predominant organism isolated in the spinal fluid of these patients was Diplococcus pneumoniae. It was identified in eight patients. All the deaths occurred in this group, except in one patient in whom no organism was identified. Reference is made to the Table for the other bacteria found.

The findings on examination of the cerebrospinal fluid were consistent with a diagnosis of meningitis in all cases. In 12 cases bacteria were cultured from the spinal fluid, and in the other 3 cases the fluid was turbid and the cell counts were 1800, 1600, and 250 per cubic millimeter, respectively.

Because of the fact that five of the six deaths in the series occurred in patients who had acute otitis media and meningitis, it seems important to review the histories of

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Read at the meeting of the Minnesota Academy of Ophthalmology and Otolaryngology, Rochester, Minn., May 23, 1956.

From the Section of Otolaryngology and Rhinology, Mayo Clinic and Mayo Foundation. The Mayo Foundation, Rochester, Minn., is a part of the Graduate School of the University of Minnesota.

these patients prior to admission to the hospital. Only very sketchy histories were obtainable in most of them. The following four patients all died on the day of admission. The case numbers correspond to the numbers in the Table.

CASE 1.—A boy, aged 9½ years, had a draining ear for 29 days. In the two days prior to admission, he had headache, vomiting, and convulsions. On the day prior to admission he had been given four or five sulfonamide tablets.

CASE 2.—A man, aged 43 years, had earache three weeks before admission. He was given penicillin injections for three days at that time. Seven days before admission he had recurrence of the earache and myringotomy was done.

CASE 5.—A male baby, aged 4 months, had fever for six days prior to admission. He was given pills for his fever, but the type of medication is not known.

CASE 13.—A girl, aged 6 years, had acute otitis media four days before admission. She was given an injection of benzathine penicillin G (Bicillin), 600,000 units.

It would appear that none of this group had adequate therapy for acute otitis media before meningitis developed. One had a spontaneously draining ear, and in one

Data on Cases of Otitic Meningitis

Case	Year	Sex	Age	Otologic Diagnosis	Otologic Treatment	Bacteria Isolated
1	1946	M	9½ yr.	Acute otitis media	None (ear draining)	None
2	1946	M	43 yr.	Acute otitis media	None	Diplococcus pneumoniae
3	1947	F	46 yr.	Chronic otitis media and mastoiditis	Radical mastoidectomy	D. pneumoniae
4	1947	M	15 mo.	Acute otitis media	None	D. pneumoniae
5	1948	M	4 mo.	Acute otitis media	None	D. pneumoniae
6	1948	M	58 yr.	Acute otitis media	Myringotomy	D. pneumoniae
7	1948	M	53 yr.	Chronic otitis media and mastoiditis	Radical mastoidectomy	D. pneumoniae
8	1949	M	45 yr.	Chronic otitis media, labyrinthitis, and mastoiditis	Radical mastoidectomy and labyrinthectomy	Escherichia coli; Proteus
9	1950	M	27 yr.	Chronic otitis media, cholesteatoma, epidural abscess, and mastoiditis	Radical mastoidectomy; drainage of epidural abscess	None
10	1951	M	10 yr.	Chronic otitis media, mastoiditis, epidural abscess, cholesteatoma, and facial paralysis	Radical mastoidectomy; drainage of epidural abscess	Proteus
11	1952	M	11 mo.	Acute otitis media	Myringotomy	Hemophilus influenzae
12	1953	F	2 yr.	Acute otitis media	None	Micrococcus pyogenes (throat)
13	1953	F	6 yr.	Acute otitis media	None	D. pneumoniae
14	1954	M	54 yr.	Chronic otitis media, mastoiditis, cholesteatoma, labyrinth fistula, and foreign body in middle ear	Radical mastoidectomy	Proteus; Micrococcus
15	1955	M	55 yr.	Recurrent otitis media	None	D. pneumoniae

Data on Cases of Otitic Meningitis—Continued

Antibiotics and Chemotherapy				Results
Penicillin (Units)	Streptomycin Sulfate, Dihydrostreptomycin	Sulfonamide	Others	
90,000				Death, 1 day
415,000				Death, 1 day
6,040,000		80.0 gm. sulfamerazine		Recovered
1,950,000		17.5 gm. sulfadiazine		Recovered
40,000 10,000 intrathecally				Death, 1 day
1,500,000		22.0 gm. sulfadiazine		Death, 3 days
9,000,000		165 gm. triple sulfonamides		Recovered
6,900,000	3.0 gm. streptomycin; 13.0 gm. dihydrostreptomycin	80 gm.		Recovered
7,000,000	16.0 gm. dihydrostreptomycin		18.5 gm. chlortetracycline	Recovered
4,500,000	24.0 gm. dihydrostreptomycin	100 gm.	28.0 gm. tetracycline; 16.0 gm. chloramphenicol	Recovered
6,300,000	3.7 gm. dihydrostreptomycin			Recovered
6,300,000	2.7 gm. dihydrostreptomycin		3.15 gm. erythromycin	Recovered
200,000	0.5 gm. dihydrostreptomycin			Death, 1 day
	7.0 gm. Distrycin	22.0 gm. sulfadiazine	25.0 gm. tetracycline	Recovered
32,000,000	3.5 gm. dihydrostreptomycin	16.0 gm. sulfadiazine		Death, 4 days

myringotomy had been done one week previously. In the other two patients the ear was not draining and myringotomy was not done because of the paucity of findings on otoscopic examination. The question of whether myringotomy should have been done cannot be settled from the data at hand. These patients were all admitted with full-blown meningitis and there was probably insufficient time in which to institute adequate therapy before death supervened. McLay [1] has stated that since the introduction of penicillin it has not been necessary to carry out any other operation than paracentesis in cases of meningitis occurring with otitis media.

CASE 6.—A man, aged 58 years, developed otitis media and meningitis while in the hospital for treatment of leg ulcers. He had earache for several days before complaining about it.

This patient died in spite of myringotomy and antibiotic therapy. It would appear, however, that his dosage of penicillin was small in comparison with the dosage received by most patients who recovered.

CASE 4.—A male baby, aged 15 months, had fever and inflamed ears for two days prior to

admission. He had been given a sulfonamide every four hours during this period.

CASE 11.—A male baby, aged 11 months, had fever and an inflamed ear for five days. Penicillin, 300,000 units, was given by injection four days before admission, followed by chlortetracycline (Aureomycin), 50 mg. four times daily.

CASE 12.—A girl, aged 2 years, had fever and vomiting for one week. She was given an injection of penicillin six days before admission, followed by oxytetratycline (Terramycin), 240 mg. daily.

These three patients all recovered, and it seems from the history available that they had received more antibiotic and chemotherapy than the ones who died.

Those patients who had meningitis associated with chronic otitis media all had otologic surgical treatment. Radical mastoidectomy was done in all cases, with removal of cholesteatoma where it was present and whatever other surgical procedure was indicated by the findings at the time of operation. In two cases epidural abscesses were found and drained. In one case a foreign body was removed from the middle ear. All these patients also received adequate antibiotic therapy and chemotherapy, and all recovered. These results confirm the statements of Elsen, Friedman, and Leshin [2] and Freedman, Love, and Hallberg [3] that surgical elimination of the otitic focus, together with antibiotic therapy, is necessary in cases of meningitis associated with chronic otitis media.

The last patient (Case 15) was not seen by an otologist. There was a history of earache and drainage 21 months and 5 months before admission. Two weeks before he was seen he had a recurrence of infection in the same ear, which drained spontaneously. Headache began and the patient became irrational two days before admission. He was given a penicillin injection followed by oral penicillin for one day. It was never determined whether he had recurrent acute otitis media or an exacerbation of chronic otitis media. In spite of vigorous antibiotic therapy and repeated lumbar punctures, he died on the fourth day.

Summary

Data on a group of patients who had meningitis associated with acute or chronic otitis media are presented. The medical and otologic surgical treatment that each patient received is described, and an attempt is made to evaluate the results of therapy.

This group of 15 patients is probably too small to enable one to draw any significant statistical conclusions.

Five of the six deaths occurred in patients with acute otitis media, and the sixth death occurred in a patient in whom it was not determined whether the otitis was acute or chronic.

Five of the six deaths occurred in patients in whom Diplococcus pneumoniae was identified in the spinal fluid; in the sixth death, no organism was identified.

All the patients who had meningitis with chronic otitis media received appropriate otologic surgical treatment and adequate antibiotic and chemotherapy, and all recovered.

It seems probable that, in these patients who died, the diagnosis of otitis media or meningitis was not made early enough or that adequate antibiotic therapy or chemotherapy had not been given prior to hospital admission.

Those patients with acute otitis media and meningitis who recovered all received relatively large doses of antibiotic agents and sulfonamide.

Conclusions

1. Meningitis is a relatively rare complication of otitis media, but when it does occur it is extremely serious. In our series the mortality rate was 40%.

2. Surgical elimination of the otitic focus, together with adequate antibiotic therapy and chemotherapy, has resulted in recovery from meningitis in all our cases associated with chronic otitis media.

3. Early diagnosis and vigorous treatment of acute otitis media would seem indicated if cases of fulminating meningitis resulting from otitis media are to be prevented.

4. Early diagnosis of meningitis by means of spinal puncture in patients with unexplained fever, convulsions, and headache would result in earlier institution of adequate therapy.

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Surgical Approaches to the Pyriform Sinus

NORMAN JESBERG, M.D., Los Angeles

As a preface it should be mentioned that Sebileau * accurately described the general area of the larynx and hypopharynx as the crossroads of the air and food passages ("carrefour aero-digestif"). This concept is particularly applicable to the pyriform sinuses, which are in a preeminent position to refer symptoms to both structures. A wide variety of diseases, offering interesting diagnostic and therapeutic problems, may originate in this portion of the hypopharynx, which may be approached by both peroral and external surgical procedures.

Anatomically the hypopharynx is that portion of the pharynx extending from the hyoid bone to the lower border of the cricoid cartilage. The aperture of the larynx communicates with it, and the inferior constrictor muscles (thyropharyngeus and cricopharyngeus) provide muscular support and coordinated action. The pyriform sinus is that portion on each side of the laryngeal orifice bounded laterally by the ala of the thyroid cartilage and thyrohyoid membrane and medially by the aryepiglottic fold and cricoid cartilage. The sinus extends obliquely in an anterolateral direction and terminates in a blind pouch between the cricoid and thyroid cartilages. Posteriorly it is in communication with the retrocricoid portion of the hypopharynx, which, in turn, communicates with the pyriform sinus of the opposite side. At the lower end of the cricopharyngeus muscle, then, this funnel-shaped system empties into the esophagus proper (Fig. 1).

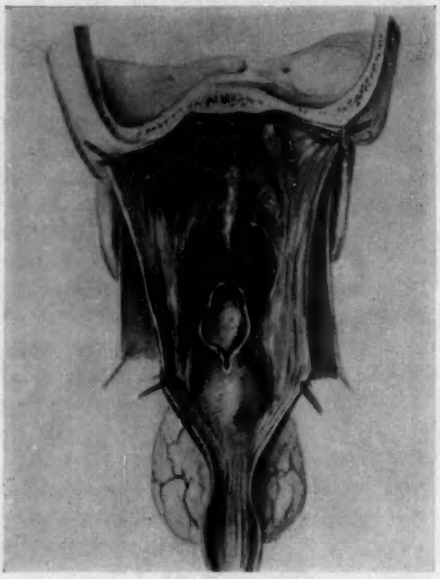

Fig. 1.—A drawing of the pharynx opened from behind showing the pyriform sinuses and their relationships to the larynx and the rest of the hypopharynx.

The functions of the pyriform sinuses are not entirely clear, but they appear to direct and collect food and secretions during the coordinated act of deglutition prior to the propulsion of these substances into the lower part of the hypopharynx and upper esophagus. They must, therefore, act somewhat as way stations during normal deglutition.

As has been recently reemphasized by Hoover,[2] disturbances in coordinated deglutition, such as those found in mechanical obstructions of the esophagus and in paralyses of the inferior constrictor muscles, result in faulty emptying of the pyriform sinuses. Indeed, one of the most important

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From the Los Angeles Eye and Ear Hospital and the Department of Otolaryngology of the University of Southern California School of Medicine.

* Sebileau, cited by Colledge.[1]

signs of disease in this region is a persistent accumulation of mucus in the pyriform sinuses. In the case of pulsion diverticulum, where the diverticular opening invariably communicates with the posterolateral portion of the retrocricoid hypopharynx, secretions may often be seen to fill the ipsilateral sinus. Another characteristic sign of pulsion diverticulum is the audible fremitus of fluid and air on compression of the neck, which is referred to by Jackson[3] as Boyce's sign. The earliest objective finding in hidden carcinoma starting deep in the pyriform sinus may be an accumulation of secretions, and not until the growth has reached considerable size do we see subepithelial thickening of the aryepiglottic fold, mucous membrane ulceration, or vocal cord paralysis.

Indirect Laryngoscopic and Hypopharyngoscopic Techniques

These anatomical and physiological facts make the pyriform sinuses particularly prone to certain accidents. They are favorite resting places for foreign bodies. Tacks, nails, pins, needles, bones, and other linear objects are particularly likely to become fixed, for a time at least, in a pyriform sinus. This is in contradistinction to discs and globular objects, which tend to become engaged in the upper esophagus, as has been reported by S. Jesberg.[4] If one is fortunate enough to see this type of patient at an early stage the foreign body may often be visible. Removal may easily be accomplished as an office procedure utilizing indirect surgical techniques. After the application of a topical anesthetic, the patient is asked to hold his tongue out with his left hand. A curved forceps may then be guided by indirect observation with a mirror held in the left hand. A forceps with a removable grasping tip is most useful, as the tip can be twisted into a suitable position to fit the problem at hand. There is, of course, danger in this procedure that if the object cannot be properly seen and grasped it may become free at the wrong time and aspirated. There is also danger of injury to the hypopharynx if the size, shape, and full extent of the foreign body are not clearly evident to visualization or to radiographic examination. Under the proper conditions, however, indirect procedures are extremely helpful and solve some foreign-body problems with a minimum of inconvenience, as in the following instance.

Case 1.—A 22-year-old white male roofer was seen on Dec. 12, 1952. One hour previously he had swallowed a lath nail. Indirect examination of the larynx showed a long, flat-headed nail lodged in the right pyriform sinus (Fig. 2) with the head

Fig. 2.—Mirror view of the larynx showing a lath nail in the right pyriform sinus.

posterior and down. After the application of a topical anesthetic the foreign body was removed with the use of indirect laryngoscopic surgery.

Indirect methods may also be used for biopsy of visible malignant lesions in the pyriform sinus. This is accomplished with the same technique, using a biting instead of a grasping tip. In most cases of malignant disease, however, direct examination of the lesion adds further important information.

Direct Laryngoscopic and Hypopharyngoscopic Techniques

Direct endoscopic procedures are necessary in treating foreign bodies which are not in the visible field at mirror examination. An anteroposterior and lateral x-ray of the neck will often demonstrate a linear foreign

body in a pyriform sinus. Occasionally, all that is necessary to bring the object into view is to lift the larynx forward with a laryngoscope or upper-esophagoscope. Further exploration of the hypopharynx and upper esophagus may be necessary in case of more deeply seated foreign bodies. Pins, needles, and small objects may be very difficult to locate when they are either imbedded in the tissues or covered by folds of mucous membrane. The following is a case of a sewing needle in the right pyriform sinus which was not actually seen until it was removed.

CASE 2.—A 72-year-old white woman was seen on Jan. 20, 1952. Two months prior to this she had had a stroke and since then had been bedridden with complete right hemiplegia. Twelve hours before admission she had attempted to commit suicide by swallowing a dozen sewing needles. X-rays showed all the needles to be in the stomach except one, which was lodged in the right pyriform sinus with the point to the left (Fig. 3). Direct

Fig. 3.—Anteroposterior x-ray showing a sewing needle lodged in right pyriform sinus with the point to the left.

hypopharyngoscopy and upper-esophagoscopy were done on Jan. 20, 1952, with the use of local anesthesia. Elevating the larynx failed to expose the foreign body. An upper-esophagoscope was then passed into the right pyriform sinus without visualization of the needle, and then into the upper esophagus. On withdrawal of the esophagoscope the pyriform sinus was reentered and a forceps was passed into the region where the needle appeared to be in the x-ray. Although the foreign body was not visualized endoscopically, the forceps engaged something metallic, and the needle was removed. The patient was finally discharged from the hospital on Jan. 28, 1952, the remaining 11 needles having passed uneventfully.

The infrequent benign tumor, papilloma, or mucus-retension cyst of the pyriform sinus may best be dealt with by direct exposure. Moderate-sized benign tumors as in Figure 4 are removed by Jackson's [5] extubal

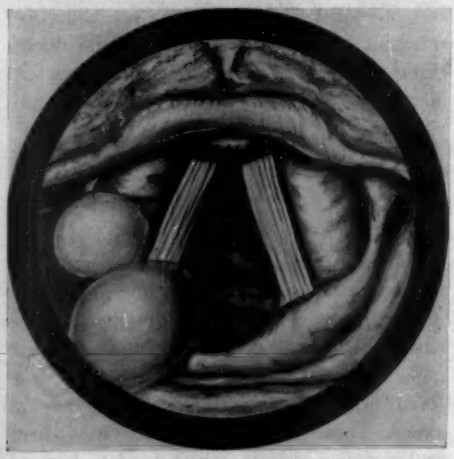

Fig. 4.—Mirror view of the larynx showing multiple fibrolipomas of the right pyriform sinus.

method, where the forceps is inserted outside of the laryngoscope, the latter being used to guide the instrument to the tumor. The growth is then removed by a snare. Pedunculated benign growths in this region are potentially lethal, as has been recently demonstrated by LeJeune.[6] Aspiration with subsequent asphyxiation may occur if the growth becomes incarcerated within the larynx.

One of the most valuable diagnostic procedures in cases of malignant growths of the pyriform sinus is direct upper-esophagoscopic and hypopharyngoscopic exposure with biopsy. One can gain valuable information regarding the lumenal extent of the growth and can to a great measure plan

the extent of resection required. Should upper-esophagoscopy reveal that a complete or almost complete resection of a segment of the pharynx is needed, one must plan the original skin incisions to accommodate a pharyngostome or make provisions for a graft.

Suspension Laryngoscopic Techniques

The utilization of the suspension laryngoscope provides a useful but seldom necessary approach to the pyriform sinus. It has been used by Thornell [7] for exposure of the

Fig. 5.—Mirror view of the larynx showing multiple fibrolipomas of the right pyriform sinus nine months after the view seen in Figure 4.

medial wall in peroral arytenoidectomy. It may also be used for large benign growths as in Figure 5. Benign tumors such as this fibrolipoma are infrequent; however, Saunders [8] recently reported a case. The case reported here developed a recurrence within one and one-half years after removal under suspension laryngoscopy and was eventually treated by lateral pharyngotomy.

Lateral Pharyngotomy

The hypopharynx and pyriform sinus may be beautifully exposed by external transthyroid lateral pharyngotomy. This approach was pioneered by Trotter † and popularized in this country by Orton.‡ It was originally planned to deal with malignant growths of the epilaryngeal portion of the hypopharynx with cervical lymph node metastases. At an early date Trotter [9] recognized the limitations of this approach in treating malignant lesions of the pyriform sinus because of the tendency in these cases for early invasion of the laryngeal cartilages. In this regard he said, "In my experience, therefore, a total laryngectomy has always been obligatory."

Transthyroid lateral pharyngotomy may be utilized, however, for exposure and removal of small malignant growths of the lateral surface of the epiglottis or aryepiglottic fold with primary closure of the pharynx (Fig. 6). It has also been used

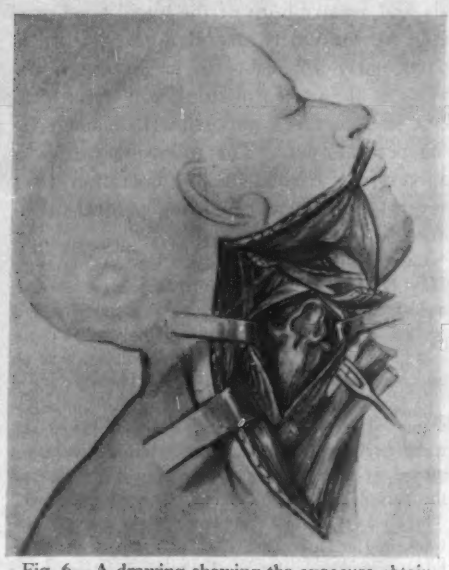

Fig. 6.—A drawing showing the exposure obtainable by transthyroid lateral pharyngotomy. A small malignant lesion of the right aryepiglottic fold is shown.

for exposure of lesions of the lateral and posterior hypopharyngeal wall and of the postcricoid area. Aside from the uncertainty of complete removal of these growths, there is a great possibility of upsetting the protective functions of the aryepiglottic sphincter of the larynx, described by Press-

† References 9-13.

‡ References 14 and 15.

man,[16] where part of the epicordal portion of the larynx must be resected. In addition to disturbing this sphincter, the superior laryngeal nerve must be interrupted, thus interfering to some extent with laryngeal sensation. Trotter's operation for large growths and postcricoid carcinoma called for either a total or an almost total resection of a segment of the pharynx, necessitating a temporary lateral pharyngostome. The pharyngostome adds greatly to the safety of this operation, as has been pointed out by Colledge,[1] but it increases the number of operations required and makes the postoperative care more difficult. Aside from these disquieting aspects, the exposure features of the lateral pharyngotomy with removal of the posterior portion of the thyroid ala and greater horn of the hyoid bone provide an extremely useful approach. It is particularly applicable to large benign tumors of the pyriform sinus, which are difficult or sometimes impossible to manage by the peroral route. The following case was successfully treated by this operation after several recurrences following peroral methods.

Case 3.—A 47-year-old white woman, first seen May 17, 1945, complained of shortness of breath on bending forward (positional dyspnea) and a feeling of a lump in the throat of one year's duration. Removal of "polyps" was done elsewhere on two occasions. Examination of the larynx showed two round, smooth, nonulcerated spheres, approximately 0.5 cm. in diameter, springing from the right aryepiglottic fold. These lesions were removed at direct laryngoscopy May 31, 1945, and the pathological diagnosis was "fibromyxolipoma." There was a gradual recurrence of the above symptoms, and in November, 1947, two smooth pedunculated growths similar to the original lesions were seen (Fig. 4), the largest being 0.75 cm. in diameter. These lesions were removed by the extubal method, and the pathological report was "fibrolipoma." Persistent swelling of the aryepiglottic fold was observed postoperatively, and two much larger subepithelial tumefactions appeared, as in Figure 5. On Aug. 17, 1948, these encapsulated subepithelial tumors were removed from the right pyriform sinus with the use of suspension laryngoscopy. Postoperatively the larynx appeared normal except for slight flattening of the aryepiglottic fold. One and one-half years later, in January, 1950, the right aryepiglottic fold thickened and a definite subepithelial bulge was seen, which gradually increased and developed into a picture identical with that in Figure 5. Transthyroid lateral pharyngotomy was performed on April 6, 1951.

Under thiopental (Pentothal) anesthesia, a right lateral incision was made and the posterior half of the thyroid ala was exposed and removed, releasing two firm, ball-like tumors, which when dissected had stalks extending into the base of the pyriform sinus (Fig. 7). After removal of the tumors, the lower hypopharynx was completely visualized. The pharyngeal mucous membrane, subcutaneous tissues, and skin were closed, and a tracheotomy was done before the intratracheal tube was removed. The tracheal cannula was removed in several days. She swallowed without leakage on the fifth day, and the wound healed per primam. She was discharged from the hospital on the eighth day and after the wound had healed appeared as in Figure 8. The pathological report, as before, was "fibrolipoma."

Fig. 7.—Gross pathological specimen of multiple fibrolipomas removed by lateral pharyngotomy.

More than five years have elapsed since lateral pharyngotomy, and there has been no recurrence of these curious growths. On all previous occasions they had recurred within two years of removal. It was not necessary to remove the lateral portion of the hyoid bone to obtain adequate exposure of the pyriform sinus; however, the advan-

Fig. 8.—The patient after transthyroid lateral pharyngotomy.

tage of removing it to visualize the upper hypopharynx is evident.

Partial Pharyngolaryngectomy

In proliferating pyriform sinus carcinoma one might occasionally be tempted, in the interests of conserving laryngeal function, to perform a partial or a hemilaryngectomy with a partial pharyngectomy, either with or without a lymph node dissection and a temporary pharyngostome, such as has been described by Alonso.[17] The surgical imagination and ingenuity which this method demonstrates are to be greatly admired, but until we possess better preoperative and operative diagnostic aids for measuring the extent of malignant growths it will be impossible to select cases suitable for this procedure. This approach is mentioned merely to suggest its inherent risks. It limits the chance for wide exposure and adequate removal of most malignant growths of the pyriform sinus. Even if the tumor can be contained, there is a great possibility that a nonphysiological laryngeal remnant will be left which can act neither as an effective sphincter nor as a useful vocal organ. Such a patient will quite likely have to retain a feeding tube and a tracheal cannula and will be unable to exclude pharyngeal secretions from the airway. As in lateral pharyngotomy, a temporary pharyngostome will add to the safety of the operation, but, everything taken into consideration, it is much safer to perform a pharyngolaryngectomy and radical neck dissection with complete separation of the food and air passages.

Pharyngolaryngectomy

Hypopharyngeal cancer in general, and of the pyriform sinus in particular, is a disease that is notoriously difficult to control. Its highly lethal nature is due both to the subtlety of early symptoms and to the difficulty of applying effective treatment when discovered. When one encounters such a growth there is a great temptation to consider it inoperable and to rely on radiological treatment. In the preradiological era Trotter[9] said, "A number of cases are lost through the undue pessimism of the surgeon," and he encouraged surgical treatment, which has been carried on in England by Colledge[1] and Owen.§ Colledge has obtained by far the best results in pharyngolaryngectomy and has reported a 37% ten-year survival rate with this operation. In America, extracordal lesions have for the most part been treated radiologically. The results of this treatment in pyriform sinus carcinoma have been particularly discouraging, and the low survival rate has made the prognosis in these cases extremely grave. This response to radiological treatment is not to be wondered at when one considers that carcinoma of the pyriform sinus is in a perfect position to infiltrate both the laryngeal cartilages and the cervical lymph nodes at an early stage. Also, effective radiation is difficult to deliver to the posterior portion of the larynx, as has been reported by Baclesse[10] and Ormerod.‖

§ Owen, R. D.: Cancer of the Pharynx, in Ellis.[18]

‖ Ormerod, F. C.: Treatment of Cancer of the Larynx, in Ellis.[18]

During the past decade, the advances made in the surgical treatment of carcinoma of the larynx have been centered around the anatomical extension of the field of surgery to conform to the pathological realities of this disease. This has been made possible by antibiotic control of infection, improved anesthesia, blood replacement, and renewed interest in rehabilitation. Schall,[20] Clerf,[21] Ogura,[22] Work,[23] and others have emphasized the necessity for a wide surgical approach. Ogura's work has shown that in advanced cancer of the larynx microscopic lymph node metastases are present in almost 40% of the cases. The principal consideration, therefore, should be the removal of the primary growth and its metastases at one operation. For practical purposes, there is not significantly greater disability after removal of the larynx, hyoid bone, strap muscles, sternomastoid muscles, and both internal jugular veins, if necessary, than there is after removal of the larynx alone, as has been shown by Bocca.[24] Although one can never expect as high survival rates with primary extracordal carcinoma as with the cordal variety, it is likely that pharyngolaryngectomy with radical neck dissection will salvage a number of cases. Wide surgical excision of the larynx, a portion or a complete segment of the pharynx, and the lateral contents of the neck, including the lymphatics, may well give a substantially higher survival rate than that obtained by x-ray therapy. Indeed, it may be possible that carcinoma of the pyriform sinus stands a better chance of cure than other forms of extracordal carcinoma, such as epiglottic carcinoma, which has a greater chance of bilateral metastases.

The exposure principle afforded by lateral pharyngotomy may be applied to great advantage in pharyngolaryngectomy. If the initial pharyngeal entry is made on the sound side of the pharynx, the larynx may be turned over, exposing to direct view the extent of the growth in the opposite pyriform sinus (Fig. 9). Accurate excision of the primary growth with a portion of normal mucous membrane may then be accomplished. If necessary, a complete segment of the pharynx may be removed, which will, of course, require either a delayed closure of the pharyngostome or a primary graft with immediate closure, as has been described by Conley.[25]

Fig. 9.—Pharyngolaryngectomy at the stage where the sound side of the hypopharynx has been transected and the larynx turned over, exposing the lesion in the left sinus.

It is entirely possible that some cases of carcinoma of the pyriform sinus will be suitable for adequate excision with primary closure of the pharyngeal defect, as is done in ordinary laryngectomy. The following is a report of a case in which this was done, making use of the information obtained by a preoperative estimate of the lumenal extent of the growth at upper-esophagoscopy:

Case 4.—A 50-year-old white man was seen on April 24, 1954, and complained of a sore throat of three months' duration. More recently he had noticed a dull pain in the left ear. Examination of the larynx showed a large ulcerating neoplasm infiltrating the medial wall of the left pyriform sinus. The growth involved the posterior portion of the larynx and extended subepithelially into and increased the size of the left aryepiglottic fold to a point where beginning laryngeal stridor was present (Fig. 10). There was no palpable

Fig. 10.—Mirror view of the larynx showing subepithelial invasion and distortion of the left aryepiglottic fold by carcinoma of the left pyriform sinus.

cervical adenopathy. Upper-esophagoscopy with biopsy was done on April 26th, and the lesion was seen to involve the postcricoid area and the left pyriform sinus, there being a considerable amount of hypopharyngeal mucous membrane on the opposite side and on the posterior pharyngeal wall, which was uninvolved. The biopsy specimen was reported as "epidermoid carcinoma, grades II and III." A lateral x-ray of the neck demonstrated rarefaction of the thyroid cartilage. Wide-field pharyngolaryngectomy with left radical neck dissection was performed on May 5, 1954. Under intravenous thiopental anesthesia a large U-incision was made, starting at the tip of the left mastoid process and extending up to the middle of the right sternomastoid muscle. The flap was elevated. The left sternomastoid muscle, internal jugular vein, associated lymph nodes, left thyroid lobe, strap muscles, hyoid bone, and larynx were all removed en bloc. The dissection of the lateral contents of the neck was done first, and the trachea was transected. The right side of the hypopharynx was then transected, and the larynx turned over, exposing to direct inspection the mucous membrane surfaces of the tumor in the left pyriform sinus. The growth itself was then made the center for the plan of excision. There was sufficient hypopharyngeal membrane left after adequate excision to close the pharyngeal defect primarily. The wound healed quickly; he started to swallow on the sixth day and was discharged from the hospital on the ninth day. The surgical specimen appeared as in Figure 11. Neither preoperative nor postoperative radiation therapy was given. Pathological examination revealed that none of seven enlarged lymph nodes, including the deep superior cervical lymph node, contained metastatic neoplastic disease. All of them, however, showed reactive hyperplasia. He developed an excellent esophageal voice after three lessons and is working at his regular job as a truck driver at the present time without evidence of recurrent disease (Fig. 12).

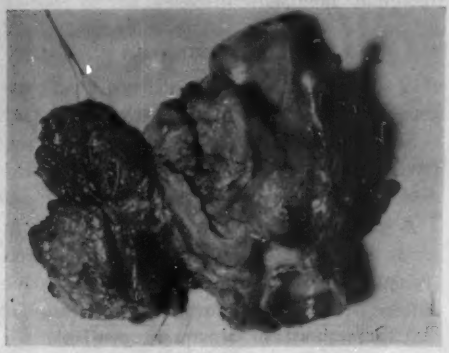

Fig. 11.—Surgical specimen showing ulcerating carcinomatous lesion of the left pyriform sinus, held open by a paper clip.

Fig. 12.—Patient after pharyngolaryngectomy and left radical neck dissection.

Although it has been only two years since this operation was performed, it would appear from the clinical course and the surgical-pathological information that the

favorable result will be sustained. It is of interest to note that although the primary lesion was large and in a location where regional lymph node metastases would be expected, no metastasis could be found. This finding illustrates the unpredictability of malignant neoplastic disease.

Summary

A general review of the surgical approaches to the pyriform sinus is presented.

Several cases of foreign bodies of the pyriform sinus are reported, illustrating indirect and direct methods of removal.

A case of fibrolipoma of the pyriform sinus is presented which eventually required transthyroid lateral pharyngotomy after failure of all peroral surgical techniques.

The methods of treatment available for malignant disease of the pyriform sinus are discussed, and a case which was successfully treated by pharyngolaryngectomy and ipsilateral radical neck dissection is presented.

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Congenital Bilateral Choanal Atresia

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Congenital choanal atresia, a rare condition in children, is characterized by closure of the posterior nares by a partition that may be membranous, membrano-osseous or osseous. The condition may be bilateral or unilateral. Until recent years a low index of suspicion permitted many of these cases to escape detection. Improved diagnostic techniques should save many of these infants who formerly would have been labelled asphyxia neonatorum.

Embryology

When fusion of the maxillary and nasal processes converts the primary nasal grooves into blind sacs, there remains only one opening at the external nares. At its deep end the olfactory sac is separated from the oral cavity by the bucconasal membrane, which thins and ruptures during the seventh week to form the primary choanae. As the palate and septum develop the nasal cavities are formed from the dorsal portion of the primitive mouth cavity, and the secondary permanent choanae open into the pharynx posteriorly. Most authors feel that congenital choanal atresia is caused by failure of the bucconasal membrane to rupture, but there are some (Blegvad, Boyd, and Owens) who feel that it may be caused by an osseous projection from the horizontal portion of the palatine bone.

Anatomy

The boundaries of the definitive choanae are as follows: Medially lie the posterior border of the vomer and the nasal crest of the palatine bone; above are the ala of the vomer and the sphenoid bone; laterally, the boundary consists of the medial plate of the pterygoid process of the sphenoid along with the perpendicular plate of the palatine bone; inferiorly is the horizontal plate of the palatine bone.

Diagnosis

Bilateral choanal atresia in the newborn represents a medical emergency. The salient features are recurrent cyanosis with asphyxia, inability to nurse, and filling of the nasal cavities with mucus. The child requires constant supervision to keep the mouth open because he cannot learn to do this without aid. Medovy and Blackman stress the point that nasal breathing is instinctive in the newborn and that mouth breathing is an acquired habit in which instinct is overcome. Occasionally tracheotomy has been done to prevent asphyxiation. The child must be fed by gavage or dropper for several weeks until he develops the facility to breathe through his mouth and to eat properly. Diagnosis is confirmed by failure of a probe or catheter to pass into the nasopharynx. Also, x-rays taken with radiopaque contrast medium placed in the nose with the head in the recumbent position reveal obstruction to the passage of the substance into the nasopharynx. Bienfield emphasizes that it is essential to examine all infants with respiratory distress carefully for this malformation.

Unilateral or incomplete choanal atresia is usually not diagnosed until later in life, as it does not cause an emergency. The patient usually complains of inability to breathe through one or both nostrils. Anosmia is usually present with diminution of the sense of taste. The nasal cavity is filled with tenacious, thick mucus. In bilat-

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eral cases the vocal resonance is altered, resulting in rhinolalia clausa. In most cases there are atrophy and underdevelopment of the turbinates, narrowing of the nasal passages, and a high-arched palate.

Surgery

The type and degree of therapy depend on each individual case. In infants the time of surgery is dependent upon the degree of the patient's respiratory distress. Cinelli advises two years of waiting before undertaking surgery. Others, such as Walker, Meurman, and Hanckel, have operated in the first few weeks of life.

Several different approaches have been used. The earliest attempts were simple trephines in the occluding bone, but these soon closed. Later surgeons attempted to prevent this closure by removal of the posterior third of the septum along with the obstruction. Skin grafts came into use still later. Blair was the first in this country to use the transpalatal approach, pointing out that, especially in children, good visualization of the obstructing bone and posterior end of the septum was most easily attainable in this manner. In recent years there have been several reports (Ruddy, Owens, and Dolowitz) advising the transpalatal approach and others (Bienfield and Kazanjian) advising their modifications of an intranasal operation. In addition, Wright, Shambaugh, and Green advised the transantral approach because of the narrowing of the nasal fossae and the medially placed pterygoid process, which is often present in these cases. In each case of intranasal surgery a long postoperative routine has been described with the use of packing, catheters, rubber and/or metal tubing, and frequent dilatations. It was our feeling that, if properly done through a transpalatine approach with covering of the raw surfaces with mucosa, this prolonged difficult postoperative therapy could be avoided.

Report of a Case

A 22-month-old white girl was admitted to the New York Eye and Ear Infirmary with a diagnosis of bilateral choanal occlusion. The child was apparently getting along well on mouth breathing, and one could readily see by her appearance that she was certainly not undernourished. She was eating well in spite of her nasal obstruction. She had the usual thick nasal discharge in both nares. On the attempt to pass catheters through the nares into the nasopharynx an obstruction was met posteriorly on both sides.

Operation.—With the patient under general anesthesia a semilunar incision was made over the hard palate, the concavity facing posteriorly and the central portion about 1 in. from the edge of the hard palate. The areas of the palatine foramen were avoided so as not to interfere with blood supply. The mucous membrane and periosteum of the hard palate were elevated. The posterior mucous membrane over the choanal occlusion was likewise elevated. There was bony occlusion on both sides except for the very central portion of each atresia. The posterior third of the hard palate was removed and the mucous membrane elevated from the anterior surface of the obstruction on both sides of the septum. The posterior third of the septum and the bilateral atresia plates were then removed, so that the entrance to the nasopharynx was smooth. A not wholly successful attempt was made to cover the raw bony surface with mucosal flaps from the anterior and posterior surfaces of the occlusion. All excess mucous membrane from the septum was excised. Bleeding was controlled at the time of surgery, and no packing or tubing was inserted. The incision on the hard palate was closed with nonabsorbable surgical (silk) sutures, and the child returned to her room in excellent condition.

Postoperatively the wound in the palate healed readily, and the sutures were removed on the seventh day. The thick nasal discharge ceased almost immediately, and the child began sleeping with her mouth closed.

The child has been followed for a period of two years and the posterior nares remain patent, so that there is perfect nasal breathing and no nasal discharge.

Summary

A case of congenital bilateral choanal atresia is reported. The patient was operated on at 22 months of age. The transpalatine approach was used successfully.

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Laryngotracheobronchial Papillomatosis of Children

Report of a Case

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The purpose of this paper is to record and discuss the clinicopathological course of a case of papillomatosis of the larynx in a child. The systematic use of endoscopic, roentgenographic, and pathological observations during a total of 1405 hospital days helped to clarify the pathogenesis of the different pulmonary and bronchial manifestations observed in this patient. Papillomas continue to appear in the tracheobronchial tree, but without the exuberance and persistence with which they affected the larynx 10 years ago.

In the 30's emergency admissions to the E. N. T. service of the Children's Ward of the Presbyterian Hospital in San Juan, Puerto Rico, were remarkable for the number of cases of acute infectious laryngotracheobronchitis. In the following decade, especially after 1945, diffuse papillomatosis of the larynx became a rather frequent cause of respiratory distress necessitating emergency treatment. The latter consisted chiefly in the assurance of an adequate airway by careful removal of obstructing tumor masses from the larynx or further down, tracheotomy, bronchoscopy, and frequent physical and roentgen examinations of the chest. We have learned that in dealing with widespread tracheobronchial papillomatosis or any other type of laryngotracheobronchitis the obtaining of frequent anteroposterior and lateral films should be a routine procedure.

Oddly enough, since 1950 we have had only the present case of infantile papillomatosis. We have had adult patients with solitary papillomas of the larynx, and at present have a veteran of the First World War under treatment for multiple papillomas of the larynx and trachea.

No attempt will be made to enter into a general discussion of the subject of laryngeal papillomatosis, since it has already been thoroughly reviewed in the literature. Kohlmoos,[1] in a recent review, gives an excellent bibliography and an informative report.

In relation to primary papillomas of the trachea, there is one unusual case reported by Lukens,[2] of a boy 7 years old who had a normal larynx above the level of the vocal cords. Tracheoscopy revealed a large mass of papillomatous material almost completely obstructing the subglottic area and extending well down into the trachea.

Orton [3] brought out the value of diagnostic bronchoscopy in papillomatosis of the larynx when he reported two cases of obstructing papillomata, one at the bifurcation of the trachea and the other in the left bronchus.

Patterson [4] discusses a case of multiple papillomas of the larynx, trachea, and left bronchus. It appears that the child became free of the disease in two years after his first admission to the hospital, showing a normal functioning larynx and no signs of recurrence.

Ashmore [5] recently reported a case which he believes fulfills the requirements of true papilloma. He defined it as a rare tumor of

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the bronchus and an uncommon cause of bronchial obstruction.

On the other hand, Hitz and Oesterlin [6] have produced evidence of aerial invasion of the lungs through the bronchi by a benign papilloma primary in the larynx, while Kirchner [7] discusses the possibility of lung involvement "in situ" in the case of a 7-year-old Negro girl, resulting in death. The autopsy was reported to have shown an almost unbelievably extensive involvement of the trachea, bronchi, and lung by variously sized nodules and cavities lined by typical squamous papilloma identical with that of the larynx.

Buffmire, Clagett, and McDonald [8] are of the opinion that these neoplasms have a multicentric origin and are not metastatic tumors.

Altmann, Basek, and Stout [9] believe that if anaplastic changes develop in areas of "metaplastic" squamous epithelium the papillomas and the anaplastic changes could be regarded in a certain sense as interdependent.

Another boy, reported by McCart,[10] revealed by bronchoscopic examination the extension of laryngeal papillomas to the trachea and bronchi within a year's time. A radiograph of the chest showed evidence of obstructive emphysema. Repeated bronchoscopies and histological studies of the material removed showed that malignant changes had taken place in these bronchial "implants." The patient died of a massive pulmonary hemorrhage 11 years after the onset of the first sign of the disease, which was hoarseness, appearing when he was 7 years old.

Routine cytologic and histopathologic examination of material obtained from the larynx, trachea, and bronchi should be done as frequently as possible. "Whenever there is significant irregularity of cytologic structure or departure from the usual histologic pattern, the lesion should be regarded with suspicion." [11]

Of diagnostic and prognostic importance is the early discovery of bronchial obstruction. Chevalier and C. L. Jackson [12] have emphasized the value of direct visual inspections. Bronchograms may also reveal ob-

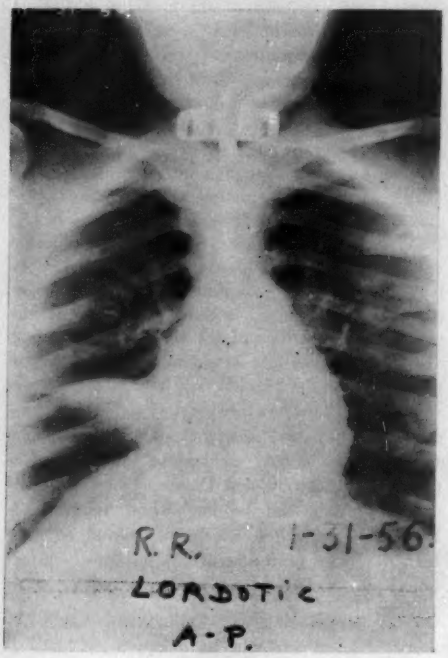

Figure 1

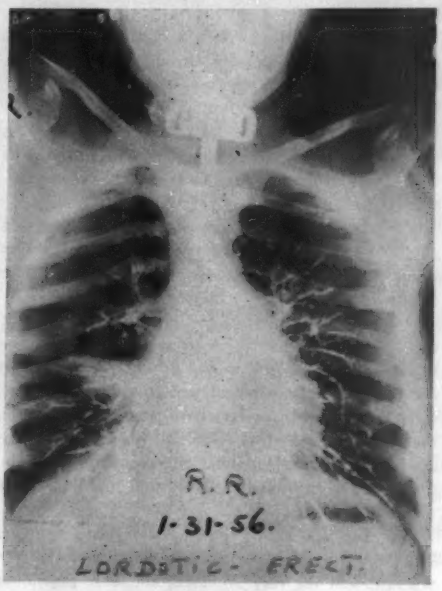

Figure 2

struction of a bronchus or incomplete filling of a segment of a lobe.

Recurrent bouts of pneumonitis due to obstruction by a papilloma produce, as seen in Figures 1 and 2, an airless and contracted middle lobe with the clinical and roentgenologic picture of the middle-lobe syndrome.

Minneto and Garbagni,[13] through the systematic use of bronchial endoscopy, have studied the pathology of benign pedunculated neoformations of the bronchial mucosa and have indicated the pathogenetic value of it in different pulmonary and bronchial nosological forms, which they define clinically as suppurative, hemoptoic, or even atelectatic.

Report of a Case

The patient, at present aged 11 years 8 months, is a white, normally developed boy. He was first seen by us 10 years ago because of progressive hoarseness following his first cold, when 48 days old. The mother volunteered the information that the child became dyspneic and sometimes cyanotic when he cried, but she believed that the whole thing was due to the cold and not to the asthmatic condition for which the baby was being treated. The child was admitted to the Presbyterian Hospital on July 30, 1946, and was finally discharged after 1047 hospital days.

On admission, the physical examination was reported negative except for the laryngoscopic findings of a cockscomb-like mass of papillomas partially obstructing the glottis. An x-ray film of the chest revealed the latter to be clear. The hemogram showed a leucocyte count of 13,150 with 62% polymorphonuclears, and a hemoglobin content of 67 gm/100 cc.

The day after admission a large pedunculated papillomatous mass was removed from the anterior commissure and tracheotomy was performed. The microscopic diagnosis was papilloma.

His prolonged stay in the hospital was in part due to the necessity of frequent removal of papillomas from the larynx and trachea and also to the frequent febrile pneumonic episodes. On Sept. 4, 1946, one of those bouts of pneumonia brought the temperature up to 105.8 F (41 C). A pure culture of a beta-hemolytic Streptococcus was obtained. The pneumonitis followed its course in spite of penicillin.

Our records show that as early as Jan. 19, 1949, there were hyperkeratotic papillomata in the trachea, and on July 26, 1950, the first papilloma occurring in a bronchus was discovered in the right main one; it was removed and examined histologically.

One of the frequent readmissions to the hospital was on Aug. 29, 1950. This time the child was given a trial treatment with corticotropin (ACTH) under strict observation by the pediatric and medical staff. He promptly developed a severe pneumonic process, which was treated with penicillin. Strict vigilance was required day and night, as the patient had various spells of cyanosis due to obstruction by the secretions and the papillomas. This episode brought the leucocyte count up to 18,500, with 81% segmented neutrophiles. An x-ray plate of the chest was reported as "a pneumonic process involving both lungs with a dense patch in the right lung at the level of the 4th anterior interspace."

The child was sent home in apparently good condition. Two weeks later, on Nov. 20, 1950, he was again admitted with very high fever (107.6 F [42 C]) and great respiratory distress. The tracheal lumen and the tracheostomy stoma were found greatly reduced by large-sized papillomas.

Topical applications of podophyllum, 25%, were made to as many of the tumors as was possible. Six days later the previously present papillomas had disappeared. However, throughout the years 1951, 1952, and 1953 the papillomata of the trachea dominated the picture. In January and May of 1951 there are in our records gross and histological diagnoses of papilloma of the bronchus, this time from the left bronchi.

In 1951 chlortetracycline (Aureomycin) was administered in large quantities over a long period of time with no convincing arguments in its favor. The same can be said of the use of estrogens and androgens; meanwhile, we have continued the scalping off and coring in multiple procedures.

Much to our consternation, numerous papillomatous masses reappeared in the larynx in January, 1954. These appear to have been the last papillomas from the larynx, but during the last two years we have seen these growths lower down in the tracheobronchial tree, i. e., in the bifurcation of the trachea, in the orifice of the right main bronchus, and in the middle-lobe bronchus. The readmission of this boy to the hospital on March 24, 1955, was for treatment of another pneumonic febrile process, clinically and roentgenologically, with the features of a typical middle-lobe syndrome. Repeated bronchoscopic and Dionosil * bronchograms definitely established the diagnosis of middle-lobe-bronchus obstruction, which is believed to have been the cause of the recurrent respiratory infections with atelectasis and/or pneumonitis, either

* The propyl ester of 3,5-diiodo-4-pyriodone-*N*-acetic acid, an analogue of iodopyracet, which is the diethanolamine salt.

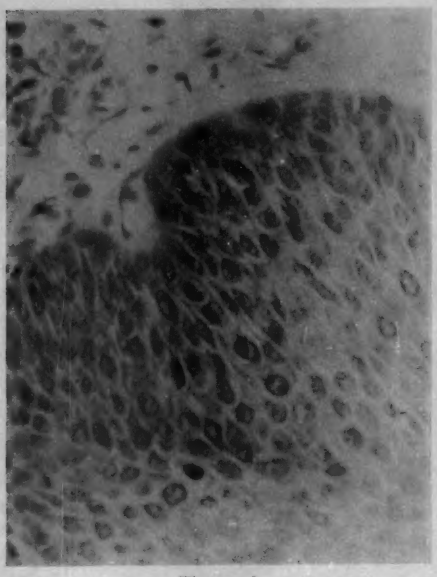

Figure 3

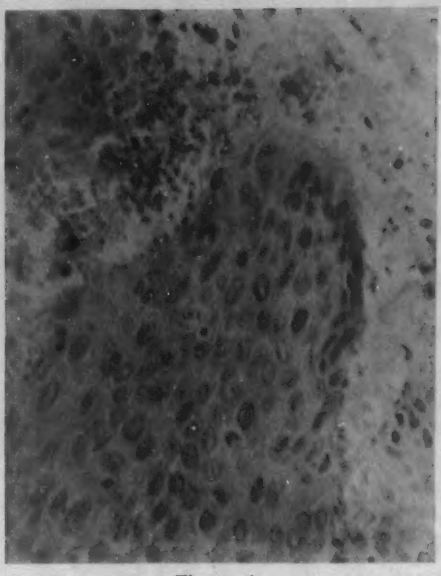

Figure 4

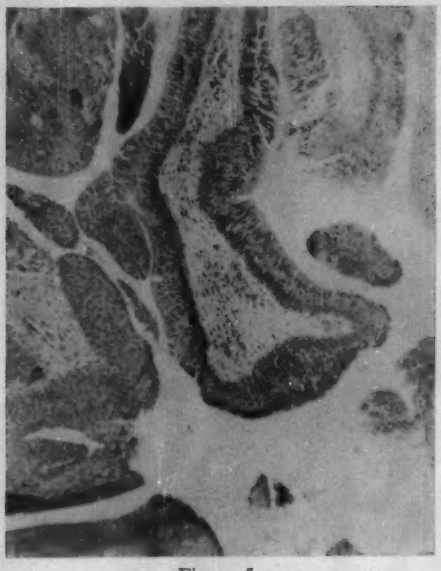

Figure 5

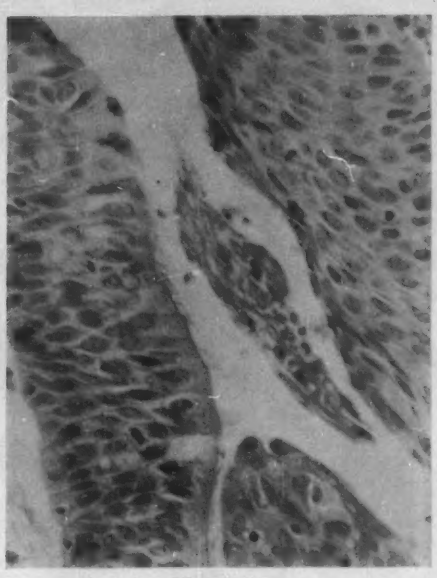

Figure 6

lobar or lobular. Removal of the obstructing papillomas from the middle-lobe bronchus reestablished ventilation and drainage of that particular area. Follow-up bronchoscopies and bronchographies have given us the impression that the relief of the obstruction was adequate and that the lung distal to the point of obstruction shows no apparent damage.

It has been our experience in this case that the use of opaque mediums, such as iodized oil U.S.P. (Lipiodol) and Dionosil, for bronchograms, has produced irritation, the result having been a productive cough with the expectoration of papillomas and with hemoptysis; only in these instances have there been hemoptoic episodes.

Summary

Emergency admissions to the E. N. T. service of the Children's Ward of the Presbyterian Hospital, San Juan, Puerto Rico, in the 30's were remarkable for the number of cases of acute infective laryngotracheobronchitis, while in the 40's a rather frequent cause of respiratory distress necessitating emergency treatment was papillomatosis of the larynx.

Of the latter group one case is reported in which, after repeated bouts of pneumonitis, roentgenologic, bronchoscopic, and bronchographic examinations showed the middle-lobe bronchus to be occluded. In the orifice of that bronchus there were papillary projections comparable to those previously and repeatedly removed from the larynx, trachea, and bronchi. The removal of this papillomatous mass allowed drainage and ventilation of the atelectatic middle lobe.

Recurrent bouts of pneumonitis more than likely will always indicate bronchial obstruction, and treatment should aim to relieve the obstruction and reestablish free drainage of the bronchial tree.

All the papillomas have shown a benign histologic structure. Most of them were composed of squamous epithelial cells (Figs. 3 and 4), and some were hyperkeratotic. One or two of those removed from the trachea presented portions composed of columnar epithelium of ciliated type, alternating with areas of squamous epithelium (Figs. 5 and 6).

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Anesthesia for Surgery of the Nose, Pharynx, Larynx, and Trachea

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and
JOHN F. TOLAN, M.D., Seattle

Most otolaryngologists perform their own local anesthesia and engage an anesthetist (doctor or nurse) to administer the general anesthesia. This paper does not attempt to markedly alter the anesthesia methods preferred by the otolaryngologist or by his anesthetist.

The sole purpose of this paper is to make whatever anesthetic is administered safer for the patient. Therefore, it will (1) show how the all too frequent incidence of severe or fatal reactions to the topical application of local anesthetic drugs may be reduced; (2) discuss the advantages and the disadvantages of administering chlorpromazine (Thorazine, Largactil) as sedation before regional block anesthesia; (3) accent the importance of endotracheal anesthesia during the operation and in the immediate postoperative period; (4) detail how laryngospasm during thiopental (Pentothal) anesthesia may be rapidly corrected; (5) emphasize our method of using succinylcholine (Anectine) prior to intubation, which has reduced the incidence of laryngeal granuloma following intubation from eight between 1948 and 1953 to none in the past two years, although the number of intubations performed each year has increased, and (6) stress the importance of monitoring the heart beat of the child during tonsillectomy and adenoidectomy.

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From the Department of Anesthesia (Dr. Moore) and the Department of Otolaryngology (Dr. Tolan) of The Mason Clinic.

Topical Application of Local Anesthetic Drugs

Topical application of local anesthetic agents to the mucous membrane of the nose, pharynx, larynx, and trachea of a patient is a daily occurrence for most otolaryngologists. Yet, when a systemic toxic reaction occurs, otolaryngologists often display a lack of organized thought as to why reactions occur, how they may be prevented, and how they should be treated. Therefore, we wish to show (1) why severe or fatal systemic toxic reactions to local anesthetic drugs occur more frequently after topical application than after local infiltration or nerve blocks; (2) that many of these reactions are due to misuse of the anesthetic drug and may be prevented by careful prophylactic measures, and (3) how such reactions may be treated successfully.

Tetracaine (Pontocaine, Amethocaine) is the drug to be used as an example in this paper because this drug was employed in most of the recently reported cases of fatal systemic toxic reactions to local anesthetic agents applied topically.* The statements made concerning tetracaine will apply regardless of the anesthetic agent employed.

Physiological Basis for Severe or Fatal Toxic Reactions Following Topical Application.—Contrary to common belief, a true allergy (sensitivity, idiosyncrasy, hyperreactivity, etc.) to local anesthetic agents, which results in a severe "anaphylactic-like" reaction and death, is extremely rare, and 98% or more of the systemic toxic re-

* References 1-7.

actions which occur reflect a high blood level of the local anesthetic drug.† It must be realized that a reaction can be called allergic with certainty only if the patient reacts to an infinitesimal amount of the drug. But such an amount is seldom involved in the topical application of a drug to a mucous membrane. For example, only 1 cc. of 2% tetracaine contains 20 mg. of tetracaine, and even this amount cannot be termed infinitesimal.

At least two factors influence the severity of a high blood-level type of reaction. The first is the rate at which the local anesthetic agent is absorbed. Second, the severity of reaction varies according to the organ or organs first supplied by the drug-laden blood and, therefore, first to be exposed to an excessively high concentration of the drug.

The regional block method used (topical application, local infiltration, nerve block, etc.) usually determines the rapidity with which the drug is absorbed, as well as the organ or organs first supplied by the drug-laden blood. For example, with local infiltration or nerve block of the chest, the abdomen, or an extremity, absorption of the drug from the tissues is relatively slow, because the tissues per se (i. e., subcutaneous tissues, muscles, fascial planes, etc.), the hyaluronic acid in the tissues, and the relatively small blood supply of these anatomical structures (as compared with the blood supply of the lung) act as barriers to rapid absorption. Furthermore, it is possible to retard absorption still more by adding epinephrine to the anesthetic solution to be injected into the body tissues.‡ Slow absorption of the local anesthetic agent into the blood stream allows its dilution of concentration by the blood as well as its detoxification by the liver to keep pace with absorption of the drug from the tissues (Figs. 1 and 2). Thus (barring an inadvertent intravascular injection while performing a local infiltration or nerve block) an extremely high blood concentration of the drug seldom reaches the heart and brain (Fig. 3).

† References 8 and 9.

‡ References 10-14.

On the other hand, topical application of a local anesthetic agent to the mucous membranes of the respiratory tract results in rapid absorption of the local anesthetic drug and permits very little dilution and detoxification. Steinhaus'[15] studies of the toxicity of local anesthetic agents in rabbits indicate that the blood level obtained after spraying a local anesthetic agent into the pharynx, larynx, and trachea is essentially equivalent to that which would follow the intravenous injection of a similar amount of the drug. This is true because all of the local anesthetic agent does not remain in the trachea, but a substantial part of it is inhaled into

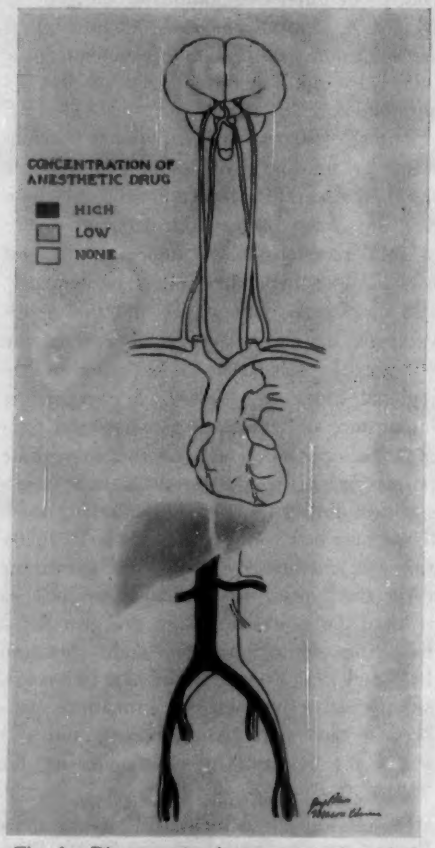

Fig. 1.—Diagram showing concentration of the local anesthetic drug in the blood of the vena cava following injection of the drug into the tissues of the lower extremity. The initial concentration of the drug used in the block has been diluted somewhat by its mixing with the blood.

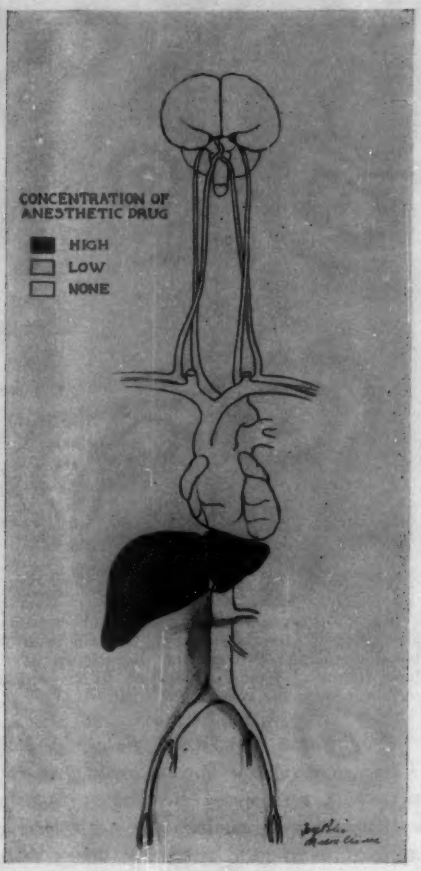

Fig. 2.—Diagram showing that the drug-laden blood from the vena cava (Fig. 1) then passes through the liver. Local anesthetic drugs are detoxified in the liver. Thus, the concentration of the drug in the blood is further reduced by the drug's passage through the liver.

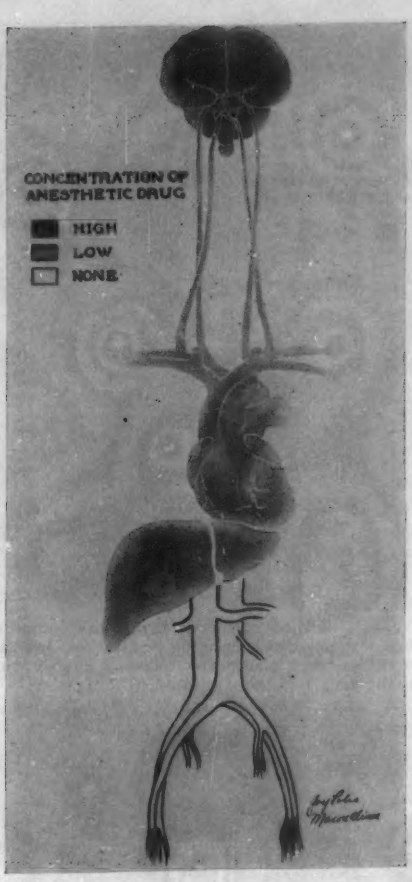

Fig. 3.—Diagram showing that by the time a local anesthetic drug injected into the tissues of the body reaches the heart and brain its concentration has been lowered in two ways: (1) by dilution with the blood and (2), if the injection has been made in an area drained by the inferior vena cava, by detoxification in the liver.

the alveoli of the lung (Fig. 4). There, a single layer of epithelial cells, which forms the lining of the alveoli and separates the alveolar sac from the rich and extensive network of the capillary blood supply of the alveoli, presents practically no barrier to immediate absorption of the drug (Fig. 5). This would mean that following the spraying of a local anesthetic drug into the trachea, an extremely high blood level of the local anesthetic drug would reach the heart immediately (Fig. 6). With little dilution or detoxification, it would be pumped to the brain (Fig. 6). This observation of Steinhaus would seem to be valid for man: Severe toxic reactions have followed spraying of the pharynx, larynx, and trachea prior to visualization of the respiratory tract, and these have been characterized by sudden fatal respiratory and cardiovascular collapse.

It is this rapid absorption from the alveoli of the lung that explains why toxic reactions following topical application of local anesthetic drugs to the air passages occur more frequently than when equal or larger amounts of such drugs are used for local infiltration or nerve block.

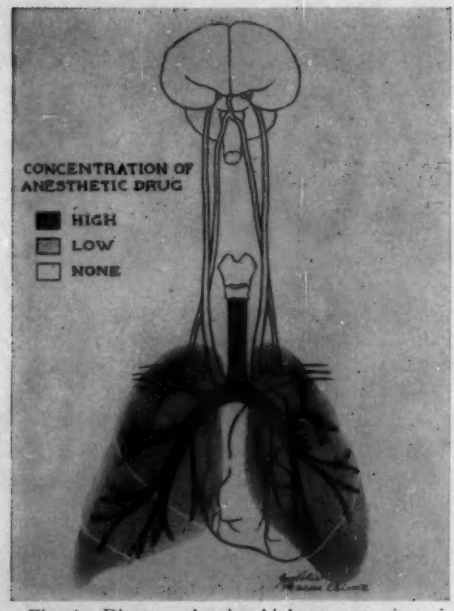

Fig. 4.—Diagram showing high concentration of the local anesthetic drug in the trachea, bronchi, bronchial tubes, and alveoli following the spraying of the drug into the trachea.

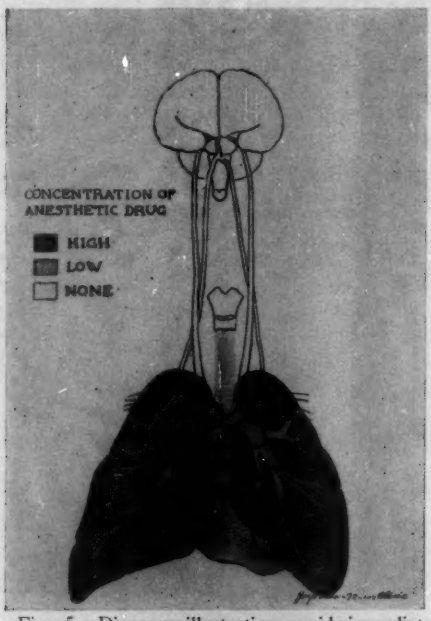

Fig. 5.—Diagram illustrating rapid immediate absorption of the local anesthetic drug into the blood circulating through the parenchyma of the lung following topical application to the mucous membranes of the respiratory tract.

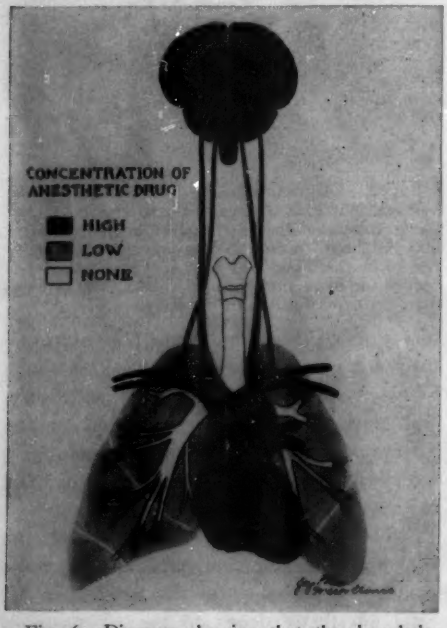

Fig. 6.—Diagram showing that the drug-laden blood from the lung is pumped directly to the heart and then to the brain with little dilution and/or detoxification occurring prior to the time these organs are perfused.

Prophylaxis of Severe Fatal Systemic Toxic Reactions.—The following precautions will reduce the incidence of severe systemic toxic reactions from the topical application of local anesthetic drugs to the nose, pharynx, larynx, and trachea.

Evaluating the Patient: The patient with a poor physical status tolerates less of the local anesthetic drug than does the patient of good physical status. In the patient whose physical status is substandard, the total amount of the local anesthetic drug must be reduced. Under no circumstances should a routine amount of drug be used in every case.

Withholding Foods and Liquids: To reduce the likelihood of vomiting and subsequent aspirations of vomitus, the patient should have nothing by mouth for six to eight hours prior to the anesthetization.

Premedication with a Barbiturate: Since the time of Tatum and associates'§ two ex-

§ References 16 and 17.

periments with animals (1925 and 1926), it has generally been accepted that premedication with a barbiturate acts as prophylaxis against systemic toxic reactions to local anesthetic agents. Therefore, most physicians who use local anesthetic drugs topically administer a barbiturate as preoperative medication, in addition to an opiate combined with a belladonna derivative.

At the present time we, as well as other physicians, feel that while a barbiturate may be useful in further sedating the patient, making the entire procedure (bronchoscopy, etc.) more tolerable to the patient, it does not reduce the incidence of severe systemic toxic reactions.|| Heavy premedication, with the use of a barbiturate, often masks the early warnings (nervousness, incoherent speech, etc.) that a severe systemic toxic reaction may be developing, and thus the patient's condition appears satisfactory to the physician, although it is not. This is perfectly all right if the reaction does not progress, but if it does, the barbiturate has then actually performed a disservice by hiding these "warning signals."

A physician must not feel secure that he has eliminated or greatly reduced the likelihood of systemic toxic reactions merely by the administration of barbiturates.

Emergency Equipment and Drugs: It is of the utmost importance that no local anesthetic agent be administered topically unless the following equipment is immediately available: (1) a source of oxygen to which a bag and mask is connected, so that a patient exhibiting the signs and symptoms of a reaction may be given oxygen and one whose respirations have ceased may be given effective artificial respiration with oxygen; (2) oral airways, endotracheal tubes, laryngoscopes, and bronchoscopes to establish a patient airway; (3) suction for immediate use in the event of emesis by an unconscious patient; (4) an intravenous infusion set with a bottle of 5% dextrose in water for injection U. S. P. to provide an available route to administer drugs intravenously; (5) ampules of vasoconstrictor drugs, e. g., ephedrine sulfate, phenylephrine (Neo-Synephrine), etc., to combat hypotension, and (6) thiopental solution (0.6%-2.5%) for intravenous injection to control convulsions.

Equally important is the presence of a physician who does not become frantic when a severe systemic reaction occurs and who is adept at starting an intravenous infusion, establishing a patent airway with an oral airway or, when necessary, with an endotracheal tube, and manually ventilating the patient with a bag and mask.

Dose of the Local Anesthetic Drug: The least amount of topical anesthetic agent that will supply the required anesthesia should be employed. Often the form (i. e., liquid or crystal) as well as the volume and concentration in which a local anesthetic drug is packaged are determined by the competitive market price of the drug and a convenient form for use. Drug companies, when preparing a local anesthetic drug for topical usage, seldom give consideration to the dosage required by any one patient—this is left to the physician who is to use the drug, and, unfortunately, he may have little knowledge of the drug's pharmacology and may not take the time to read the instructions for its use. Just because a drug comes in a convenient, economical form, it must not be used haphazardly. It is our opinion that in the greater majority of the deaths which have been reported following topical application a concentration and volume of the local anesthetic drug must have been employed which were excessive for the person being anesthetized and that the death was caused not by an allergy, but by an excessively high blood level of the drug, that is, by an overdose. We must remember that a reaction can be termed allergic only if infinitesimal amounts of a drug have been administered.

Certainly 4-5 cc. of a 2% tetracaine solution (i. e., 80-100 mg., or approximately one-fourth of the volume of the reservoir

|| References 8, 15, 18, and 19.

which the standard DeVilbiss atomizer [No. 27] holds) cannot be considered anything but an overdosage of the drug when it is used in the respiratory tree, where absorption is so rapid that the subsequent blood level of the drug approximates an intravenous injection (Fig. 7). Package literature warns that "for anesthetizing the larynx, trachea or esophagus, the total absorbed dose of [tetracaine] Pontocaine should not exceed 20 mg. (0.02 gm.) except in special techniques which have been carefully worked out." Carabelli's [20] method of anesthetizing these structures does not require an amount greater than this.

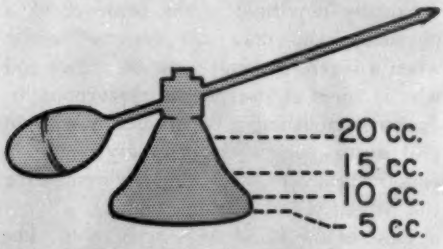

Fig. 7.—Diagram showing the number of cubic centimeters which the reservoir of a DeVilbiss (No. 27) atomizer will hold.

This seems an overcautious dosage. Clinical experience at The Mason Clinic and elsewhere indicates that 40-50 mg. of tetracaine (2-2.5 cc. of a 2% solution) may be safely used topically in most patients without provoking any form of a systemic toxic reaction, and yet produce satisfactory anesthesia. However, the 2% solution must be diluted to a 0.5%-0.25% solution, and 3 to 4 cc. of the solution may then be used to anesthetize the mouth, pharynx, and vocal cords, and an additional 3 cc. may be used to anesthetize the trachea. At no one time should more than 3 cc., even of these weak concentrations, be administered directly into the trachea. If it is necessary to apply an additional 3 cc. to the trachea to effect anesthesia, five minutes must first be allowed to elapse. This waiting period permits detoxification by the liver of that part of the previous tracheal dose which was inhaled into the alveoli and rapidly absorbed into the blood stream.

Unfortunately, although tetracaine is a rapidly effective topical anesthetic in concentrations of 0.25%-0.5% (onset in five minutes), it is available for topical application only in a bottle containing 4 oz. (118 cc.) of a 2% concentration. Therefore, the physician who is using it should pour 2 cc. of the solution into a graduated measuring cup and dilute it with at least 6 cc. of isotonic saline.¶ This would result in 8 cc. of a 0.5% solution (40 mg.). If a larger volume of solution is needed, then more isotonic saline, not tetracaine, may be added; 14 cc. of isotonic saline added to 2 cc. of 2% tetracaine (40 mg.) gives 16 cc. of 0.25% solution. Seldom, if ever, is it necessary to exceed these amounts or concentrations of tetracaine to obtain satisfactory anesthesia of the pharynx, larynx, trachea, and bronchi.

Use of a Vasoconstrictor Drug: Some physicians add 0.10 to 0.25 cc. of epinephrine, 1:1000, to the measured amount of local anesthetic solution to be applied to the mucous membrane. But it is debatable whether this is useful either in retarding absorption of the local anesthetic drug or in prolonging anesthesia. Steinhaus [15] indicates it is not; Kelsall [22] believes it is. Probably it is permissible to employ this amount of epinephrine, since it is easily measured with a small syringe and is not likely to produce an "epinephrine-like" reaction.

Signs and Symptoms of a Severe Systemic Toxic Reaction.—A systemic toxic reaction to a local anesthetic drug usually starts with the patient complaining of a faint, giddy feeling or the sensation of "blacking-out." His speech becomes incoherent and irrational, and unconsciousness and apnea ensue. Twitchings of the fingers may follow, which often rapidly develop into generalized convulsions. Vomiting, with or without aspiration, may occur. Untreated, the patient may convulse two or three more times, get progressively worse, and die. Usually these signs and symptoms following topical application of a local anes-

¶ References 20 and 21.

thetic agent progress more rapidly than when they result from a regional nerve block procedure.

Muscular twitchings and convulsions, as well as vomiting, are usually attributed to overstimulation of the brain by a high concentration of the local anesthetic drug.[10] Respiratory and cardiovascular collapse are usually attributed to depression of the respiratory and cardiovascular centers in the medulla which follow their overstimulation.[10]

Treatment of a Severe Systemic Toxic Reaction.—Every physician using local anesthetic drugs should have a well thought out and orderly step-by-step routine for treatment of toxic reactions to local anesthetic

TREATMENT OF A SYSTEMIC TOXIC REACTION

Figure 8

drugs. He must not become frantic and haphazardly inject analeptics, barbiturates, etc., for these would hasten the death of the patient (Fig. 8).

Time is of essence, and therapy must be instituted immediately at the first sign of a reaction. No patient should be allowed to undergo even an early symptom of a toxic reaction without treatment, for a few simple measures will usually control the reaction and bring about an uneventful recovery. In treating a systemic toxic reaction the aim is to protect the patient from hypoxia or anoxia, hypotension, and cardiac failure until the anesthetic agent is detoxified, at which time an uneventful recovery may be expected.

Administer Oxygen Via a Patent Airway: It has been our observation that depressed respiration or apnea usually precedes cardiovascular collapse and death when a systemic toxic reaction occurs. This is singularly true when tetracaine is the responsible drug. Therefore, at the first sign of a reaction, it has become our custom at The Mason Clinic to give oxygen by bag and mask immediately (Fig. 9). The pa-

TREATMENT:

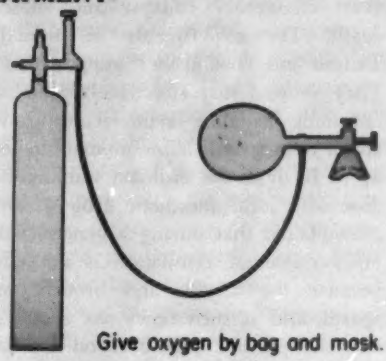

Fig. 9.—Minimal equipment for administration of oxygen, i. e., tank of oxygen, simple reducing valve, bag, and mask.

tient's respirations should be assisted if depressed, and if respiration stops, artificial respiration by rhythmical squeezing of the bag must be instituted (Fig. 10). An oral airway may be needed to effect a free airway, and if a patent airway cannot be maintained by it, the placement of an endotracheal tube should be considered. If the patient vomits, the vomitus must be cleared from the pharynx, larynx, and trachea before oxygen is given, since giving oxygen under pressure tends to push the vomitus deeper into the bronchi and alveoli.

TREATMENT: ARTIFICIAL RESPIRATION

Figure 10

We have successfully treated severe systemic toxic reactions to local anesthetic drugs, including those which have progressed to convulsions, with oxygen therapy and artificial respiration alone. This seems to indicate that in a high percentage of severe systemic toxic reactions the effective administration of oxygen alone will probably avert circulatory collapse and subsequent death. The experiments in animals by Tainter and Throndson [23] support this view. They showed that effective oxygen administration, including artificial respiration if apnea occurs, will allow animals to tolerate up to 10 times the ordinary minimum lethal dose of a local anesthetic drug. It must be remembered that during a generalized convulsion manual ventilation is not effective because the larynx and bronchi are in spasm, and at such times one should avoid extreme positive pressures on the oxygen bag, for extreme pressure would force oxygen down the esophagus and inflate the stomach. As soon as the convulsion subsides, manual respiration will be easy again.

Start Intravenous Fluids and Correct Hypotension: While the physician respirates the patient, an assistant should start an intravenous infusion of 5% dextrose in water for injection U. S. P. (Fig. 11). If there

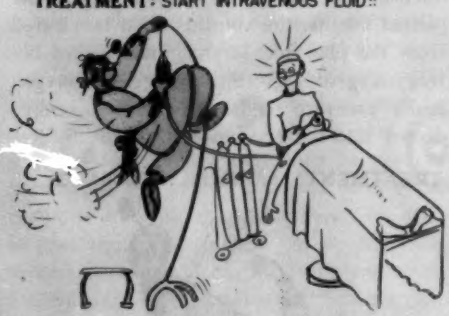

Figure 11

is a marked fall in blood pressure, a nearly normal blood pressure should be established by the administration of (1) 15-25 mg. of ephedrine sulfate intravenously—this dosage may be repeated at two- to five-minute intervals as necessary, or (2) an intravenous drip of phenylephrine consisting of 1 cc. of a 1% solution of this drug (i. e., 10 mg.) added to 1000 cc. of 5% dextrose in water for injection U. S. P.—this mixture is dripped at the rate of 100 to 180 drops per minute until the blood pressure approaches normal, and then it is slowed to a drip that will maintain this blood pressure until the reaction has passed (Fig. 12).

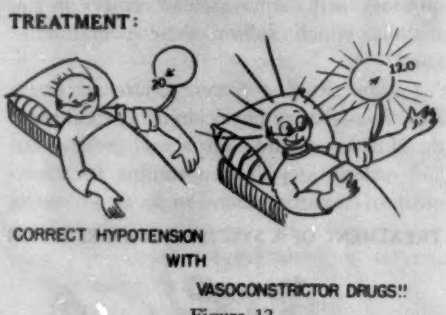

Figure 12

Stop Convulsions: If, after one or two general convulsions, it appears that adequate oxygenation of the patient alone does not effectively prevent further convulsions, then, and only then, thiopental (0.6% by drip or 2.5% solution from a syringe) should be given intravenously, sparingly, to control the convulsions (Fig. 13). Fifty to one hundred milligram doses are usually sufficient to reduce the severity of or control the convulsions. It is seldom necessary to exceed a total dosage of 100 to 300 mg. of thiopental. Too much thiopental will add to the respiratory depression which will follow convulsions. It may be necessary to breath manually for the patient for up to 30

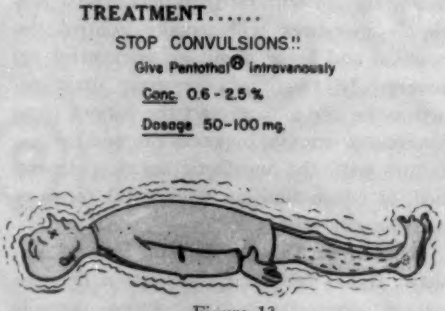

Figure 13

minutes, at which time the patient should return to consciousness and complete recovery.

Do Not Give Analeptics: Analeptics (Caffeine, pentylenetetrazol [Metrazol], etc.) are contraindicated, as they increase the oxygen demand of cells and may accentuate the depression which will follow overstimulation.

Chlorpromazine (Thorazine, Largactil)

In our opinion, barbiturates afford very little protection against a severe toxic reaction following the administration of a local anesthetic drug. They only mask the early signs. Therefore, it was decided that when local anesthesia was to be used chlorpromazine sedation should be tried as a substitute for the barbiturate sedation to see if it had any distinct advantage in reducing the patient's apprehension, etc. When chlorpromazine is used at The Mason Clinic, it is employed only as a substitute for the barbiturates and it is used along with the usual preoperative hypodermic injection of the opiates and belladonna drugs.

Dosage.—After trying oral, intramuscular, and intravenous administration, it was finally decided that the most satisfactory method of administering the drug was to inject it intravenously one-half hour before surgery. Therefore, 1 cc. (25 mg.) of chlorpromazine is diluted with isotonic saline in a 5 cc. syringe, so that each cubic centimeter contains 5 mg. Depending on the size and age of the patient, 10 to 20 mg. is administered.

Advantages.—Following injection, the patient usually becomes more somnolent, will react to stimulation and questioning, but when he does so, it is not as if he has been startled. On the contrary, movement and speech are slow and more deliberate. This is extremely important when an operation is being performed under local anesthesia, for under such circumstances, if the anesthesia is inadequate and the patient is hurt and reacts by jerking his head at a crucial moment, the operation may not be a success and the patient may be harmed. It has been our finding that the patient who receives chlorpromazine and who is hurt during the operation seldom responds by a jerky movement. On the other hand, he may only wrinkle his forehead, slowly move his head, or, most often, merely comment that he is being hurt. This allows the surgeon time to stop operating and inject more of the local anesthetic solution before the patient moves rapidly and causes irreparable damage.

Disadvantages.—After the intravenous administration of chlorpromazine, it is not unusual for a tachycardia to ensue for 5 to 15 minutes. After this interval, the pulse rate usually reverts to the rate which existed prior to the injection of chlorpromazine. To date no untoward effects from this tachycardia have been noted.

Another minor complication occurs infrequently from the intravenous administration: restlessness and/or the patient complaining of the difficulty of "getting his breath." The intravenous administration of 75 to 150 mg. of pentobarbital (Nembutal) has been most helpful in correcting either or both of these sequelae.

The only other complication which has been observed following intravenously administered single doses of chlorpromazine at The Mason Clinic, and which is most troublesome of the complications noted here, is hypotension. Blood-pressure falls of 80 to 90 mg. Hg. have been observed, particularly in hypertensive patients. We have seen, for example, a patient with a blood pressure of 180/80 have a blood pressure of 70/40 after the use of this drug. It does not appear possible to predict the type of patient who will exhibit this blood-pressure fall. To date we have seen no complications from this blood-pressure fall when chlorpromazine has been used in conjunction with topical application. However, this does not mean that a severe blood-pressure fall caused by this drug may not precipitate a coronary or cerebral occlusion in a patient with arteriosclerotic vascular disease.

The blood-pressure fall after the use of

chlorpromazine responds well to an intravenous drip of phenylephrine (1 cc. of 1% [10 mg.] in 1000 cc. of intravenous fluids) or of levarterenol (Levophed) (8 mg. in 1000 cc. of intravenous fluids). Either of these vasoconstrictor drugs must be administered continuously by the intravenous drip method until the effects of the chlorpromazine have passed—usually in six hours. Otherwise, the blood pressure will fall again to the low level. Hypotension, following administration of chlorpromazine, seldom responds well to intramuscular doses or single intravenous doses of these drugs or to other vasoconstrictor agents, such as methoxamine (Vasoxyl), methamphetamine (Methedrine), etc. Likewise, an intravenous drip of epinephrine (1:250,000), which is used in England to treat hypotension, is of no avail, since chlorpromazine cancels the effect of epinephrine.[25] This brings attention to the fact that if a massive dose of epinephrine, which may be fatal, is injected inadvertently, chlorpromazine, 10 mg., may be given intravenously to reverse the effect of epinephrine and, used in this fashion, may be lifesaving.

Endotracheal Intubation

Indications for Intubation.—Satisfactory anesthesia for long or tedious surgical procedures of the head and neck is perhaps one of the most difficult types of anesthesia to administer in a way that satisfies the requirements of the patient, the surgeon, and the anesthesiologist. Regional analgesia may be employed satisfactorily for short superficial procedures, since the correctly medicated patient will usually tolerate uncomfortable positions, the feeling of suffocation from drapes, and manipulation discomforts for limited periods. However, during long and/or tedious procedures requiring deep manipulations of the face, pharynx, larynx, or trachea, the constant cooperation of the patient must not be relied on. Restlessness and motion at a crucial point by a patient who was thought to be cooperative may prove disastrous to the patient or to the operative result being sought. Equally as catastrophic may be the administration of an intravenous, rectal, or inhalation anesthesia to a patient who was started under regional anesthesia and whose airway has been made inaccessible by the drapes or the surgery. Therefore, in long and/or tedious procedures of the head and neck, general anesthesia with an endotracheal tube is the only entirely satisfactory means of establishing anesthesia and being assured that the patient's airway will remain patent.

Thiopental anesthesia has attained great favor with patients because they are not aware of the difficulties in which the administration of this agent may result. From the patient's standpoint he merely goes to sleep. Unfortunately, thiopental makes the laryngeal reflex hyperreactive, and any manipulation or foreign body (this includes mucus, blood, etc.) coming in contact with the larynx may initiate a severe laryngospasm. Therefore, with thiopental anesthesia it is wise to have the patient intubated or be prepared to intubate the patient. At The Mason Clinic, intubation is performed in all cases prior to draping, since once the patient is draped and the operation started the otolaryngologist is usually reluctant to have intubation performed.

Treatment for Laryngospasm.—Laryngospasm during intravenous thiopental anesthesia has always been a challenge and often a serious problem to the anesthesiologist. Many ways of overcoming a laryngospasm have been used. However, except for tracheotomy (which usually is considered such heroic treatment that it seldom is used), no certain method of overcoming the laryngospasm and delivering oxygen to the alveoli of the lung has been available. But in the past two years at The Mason Clinic we have used 20 to 40 mg. of succinylcholine intravenously to treat 35 patients who had developed a severe laryngospasm during the use of thiopental and who did not respond immediately to manual pressure on the breathing bag of the anesthetic machine.[26] In one patient, a child 5 years old, who de-

veloped a laryngospasm under light ether anesthesia, 5 mg. was employed intravenously. In every one of these cases succinylcholine was effective in relaxing the laryngospasm. To date no untoward effect has been noticed when succinylcholine is employed in this fashion. Apnea has occurred in all cases, but it never has lasted longer than five minutes.

It should be stressed that succinylcholine should not be used unless (1) the anesthesiologist is capable and prepared to administer artificial respiration by bag and mask during the time the patient is apneic from the succinylcholine and (2) intravenous succinylcholine is not used as the sole treatment for the spasm but merely as a means of oxygenating the patient while more definite therapy, such as endotracheal intubation, deepening of the level of anesthesia, etc., is accomplished.

Prevention of Granuloma of the Vocal Cords from Intubation.—In the past numerous articles have appeared which have emphasized that endotracheal anesthesia predisposes to granuloma formation on the cords of the larynx.# Eight cases of granuloma of the vocal cords have been observed at The Mason Clinic between 1948 and 1953, and on one occasion one vocal cord was completely sheared off.

In the past two years at The Mason Clinic, no granuloma of the vocal cords or damage to them has been noted, although our use of intubation has markedly increased. It is highly doubtful that during this last two-year period the residents in anesthesia, who were trained in intubation under direct supervision of an attending staff anesthesiologist, were any more adept in the actual mechanics of visualizing the larynx and placing the endotracheal tube than were those who preceded them. The only reason that will account for the absence of granuloma during these two years is the fact that 30 to 40 mg. of succinylcholine has been given intravenously immediately prior to intubation. Within two minutes after the administration of succinylcholine, the characteristic fasciculation of the muscles (that is, twitching of the muscles) and apnea occur. When apnea occurs, the patient is oxygenated thoroughly and the larynx is easily visualized with the laryngoscope under ideal conditions, since the patient and his vocal cords are completely relaxed. Now the endotracheal tube is selected and carefully inserted. The relaxed laryngeal aperture will accommodate it easily. Under these ideal circumstances an endotracheal tube need never be forced between the vocal cords.

The Endotracheal Tube as a Means of Assuring a Patent Airway in the Postoperative Period.—A final point concerning endotracheal intubation: Whenever a surgical procedure of the pharynx and neck is performed, the trauma may result in edema of the tongue and pharynx. If, in addition to this edema, the patient can not voluntarily control the musculature of the pharynx and tongue, an occluded airway may result. When such a situation is a possibility, the patient should be intubated by the nasal route. The endotracheal tube should not be withdrawn at the end of such a surgical procedure unless the patient is completely awake, but should be allowed to remain in the trachea until the patient has regained full control of his pharyngeal musculature and tongue. This precaution, in many instances, will prevent the need of a tracheotomy in the immediate postoperative period.

When the patient has awakened and the nasally inserted endotracheal tube is removed, the normal dosage of the sedation must be markedly reduced, for if the patient should fall asleep again from the administration of an opiate, he may not be able to control his tongue and it may drop back into the pharynx and occlude his airway.

Monitoring the Heart During Tonsillectomy and Adenoidectomy

One of the most unfortunate types of death which occurs in the operating room is that which results during tonsillectomy

References 27-31.

and adenoidectomy in the healthy child. This operation is singularly hazardous because instrumentation and manipulation of the tonsils and adenoids or any part of the pharynx are known to initiate vagal reflexes, which in turn slow the heart rate.* Such reflexes in the conscious patient do not cause any problem, but in an anesthetized patient, particularly one who is hypoxic, it may cause a cardiac arrest. For this particular operation (T and A), it may be difficult to avoid periodic bouts of hypoxia or anoxia during the administration of the anesthetic.

In most instances, tonsillectomies are performed in a darkened operating room—the only light being provided by the surgeon's head mirror or lamp. Consequently, the appearance of the patient may not reveal to the anesthesiologist that hypoxia is present. When hypoxia results, the heart rate or rhythm of the child is usually altered—most often the rate will decrease. Regardless of the rate of oxygen flow indicated by the gauge on the anesthetic machine, this change in cardiac action is usually an indication that inadequate oxygen is reaching the alveoli of the lungs.

It follows that if the two described conditions occur simultaneously—that is, the slowing of the heart from the manipulation in the pharynx added to myocardial hypoxia—the scene is set for a cardiac arrest. Since the manipulation is essential for the success of the operation, it is the responsibility of the anesthesiologist to make sure that hypoxia does not occur and, if it does, that it is corrected immediately.

Because the heart rate of the child may be used as an indication of his condition while he is undergoing tonsillectomy or adenoidectomy, the heart is constantly monitored at The Mason Clinic by a system similar to that described by Ploss (Fig. 14).[34] In this manner a constant check of the child's heart rate is maintained throughout the procedure. Neither the ear mold nor the tubing running to the chest piece, which is strapped over the child's heart, in any way interferes with the operative field. This constant monitoring system allows the anesthesiologist to detect any change in the patient's heart rate or rhythm. Should either the rate or rhythm change markedly, the surgeon can be asked to stop manipulations in the pharynx until the anesthesiologist is certain that no hypoxia is present. This simple precaution may possibly avoid a catastrophe.

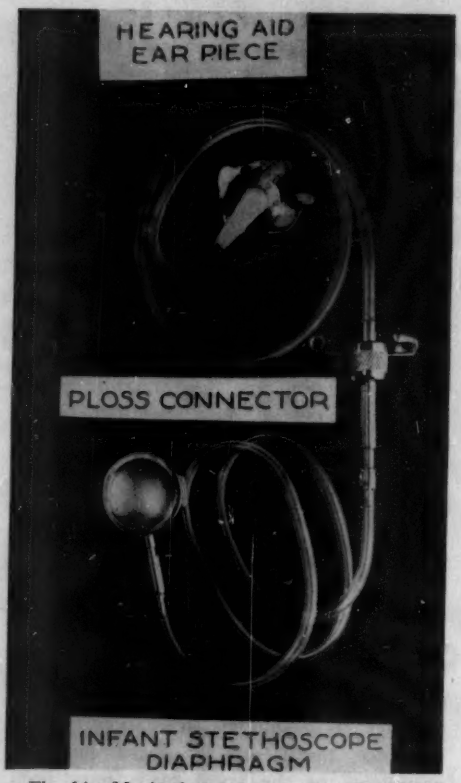

Fig. 14.—Monitoring system used at The Mason Clinic during tonsillectomies and adenoidectomies.

Summary

This paper emphasizes the following points about topical application of local anesthetic agents: (1) the anatomic explanation for the relatively high incidence of death following the instillation of these drugs into the respiratory tract; (2) ways to avoid this catastrophic reaction; (3) the

* References 32 and 33.

error in reasoning that the barbiturates are adequate prophylaxis against such a toxic reaction, or that barbiturates are an antidote for them, and (4) the fact that effective administration of oxygen is the treatment of choice when a systemic toxic reaction occurs.

In addition the paper discusses (1) the administration of chlorpromazine for oto-laryngological procedures; (2) the dangers of the use of general anesthesia, particularly thiopental (Pentothal), unless the patient is intubated; (3) the treatment of laryngospasm with succinylcholine; (4) the prevention of granuloma of the larynx associated with intubation; (5) nasal intubation as a means of maintaining a patent airway in the postoperative period, and (6) the prevention of unnecessary deaths during tonsillectomy and adenoidectomy by constant monitoring of the heart beat.

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Myoepithelial Hamartoma of Tongue

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A hamartoma is a tumor-like malformation in which the various tissues of a part are present in improper proportions or distribution with prominent excess of one particular tissue. The term "hamartoma" was designated by Albrecht (1904). Such tumor-like malformations include most angiomas, benign pigmented moles, most of the neurofibromatous masses of von Recklinghausen's disease, and the cartilage-capped multiple exostoses. Since the literature contains a fair degree of discussion on the vascular hamartomata, one must not conclude that the two words "vascular" and "hamartoma" are interchangeable or that all hamartomata are vascular in origin. As the definition of hamartoma denotes, there must be a "prominent excess of one particular tissue," whatever type of tissue it be.

The literature has been scrutinized most carefully in the search for a hamartoma of the tongue other than the vascular type. There are numerous excellent discussions and case reports of the vascular hamartomata, but no cases or discussions of the myoepithelial hamartoma. One such case was presented to this clinic in the recent past which was interpreted to be a malformation in accordance with the definition of the term malformation by Willis. The problem of diagnosis was apparent when the patient presented the tumor of the tongue. It was first thought to be an intralingual thyroglossal duct cyst, as described by Ward. It was subsequently removed, and considerable comment and discussion arose as to the rarity of such a lesion of the tongue.

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Report of a Case

A registered nurse, aged 34, in apparent good health, who stated she had never been ill for a day in her life, presented herself to the Otolaryngology Clinic with a complaint of "lump in my throat which gives me a constant desire to swallow." This situation had been present for two years. The patient stated that she thought the lump seemed to be growing larger during the past six months. On complete physical examination of her ears, nose, and throat no pathology was noted clinically except for the tongue. Upon inspection directly and by mirror examination, there was an apparent growth on the dorsum of the tongue in the midline at the foramen caecum. Clinically it appeared to be 1.5 cm. from the anterior to the posterior end, 1 cm. wide, and projected approximately 2 cm. above the surface of the tongue. The tumor was pale yellow in color, and there was apparent a clinical atrophy of the overlying mucosa. Upon palpation of the tumor all that could be determined was its outline and the fact that it probably was a cystic mass because of its soft feel. The remainder of the physical examination and laboratory studies, such as chest x-ray, complete blood cell count, hemoglobin, bleeding and coagulation, serology, and urine analysis, were all normal and negative. The conclusion that this mass was an intralingual thyroglossal duct cyst was made tentatively as a result of the location of the mass, its consistency, and the fact that intralingual thyroglossal duct cysts are commoner in this location than myoepithelial hamartomata. The patient was scheduled for surgical extirpation of the mass, which was done on Dec. 14, 1955.

Operation.—Under nasal endotracheal thiopental sodium (Pentothal) anesthesia supplemented with nitrous oxide and oxygen, stay ligatures of 00 black nonabsorbable surgical (silk) suture material were placed through the tongue musculature. Traction was made by means of these sutures in order to present the posterior portion of the tongue with a greater degree of ease. An elliptical incision was made on either side of the tumor and joined anteriorly and posteriorly. The tumor was grasped with an Allis forceps and traction made. The tumor was then dissected free with Metzenbaum scissors. All bleeding vessels were ligated. The cavity remaining in the tongue was closed by approximating the edges of the incision with 00

chromic absorbable surgical (gut) sutures. Pressure was made momentarily, and the patient was returned to the recovery ward with no bleeding. Under an antibiotic regimen her postoperative course was uneventful.

Histopathologic Description.—The following are the gross and microscopic findings.

Gross: The gross material consisted of a piece of excised tongue which measured 2.5×1.0 cm. and included 1.0 cm. of the tongue muscle. On the surface there was a single polypoid mass which was smooth-surfaced and measured 2.0 cm. in height and 1.3 cm. in the greatest diameter. It was attached by a broad base to the tongue. A section was made through the center of the lesion. The lesion was solid and a yellow-white uniform color. A section was embedded.

Microscopic: The section showed the lesion to be composed of mucous glands, bundles of smooth muscle, and adipose tissue. The mucous glands contained ducts lined by cuboidal epithelium. The lesion was covered by nonkeratinized squamous epithelium.

Diagnosis.—Myoepithelial hamartoma, benign.

Comment

The interpretation of hamartoma is based upon the organoid pattern of the lesion, which consisted principally of an admixture of smooth muscle and mucous glands. Judging from the sections examined, the lesion was completely excised (Denser and Shelley).

Summary

A definition and brief discussion of hamartoma are presented for refamiliarization in order to present to the literature a rare and probably the first myoepithelial hamartoma of the tongue.

The Armed Forces Institute of Pathology and the Armed Forces Medical Library contributed their services. Dr. Clarence Denser and Dr. William Shelley recognized the lesion.

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Effective Control of Postnasal Hemorrhage

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The usual method of controlling epistaxis from the posterior nose is through use of a postnasal pack. Unfortunately, the postnasal pack has several serious disadvantages. First, it is exceedingly uncomfortable to the patient. Second, it commonly causes middle-ear complications. Third, postnasal packs are too often used as an expedient when a more careful examination might disclose bleeding from a site amenable to local packing.

Recent articles by Hallberg,[1] Neivert,[2] and others emphasize the advantage of postnasal packs which fit one choana only. Their packs are shaped so as to provide pressure in the posterior nose rather than in the nasopharynx, where a larger pack may obstruct the Eustachian tube. Directions and illustrations for the construction of packs accompany the articles.*

Just as effective as the conventional postnasal pack and infinitely more pleasant is a small pack placed directly at the bleeding site. Fortunately, insofar as the use of this method is concerned, posterior nosebleeds usually come from the posterior end of the inferior meatus. A small compressed cotton ball can be wedged tightly into the inferior meatus at the bleeding site (Fig. 2).

This localized pack may be placed without anesthesia and is usually easy to press under the inferior turbinate with a stiff probe or forceps. It may be lubricated with petrolatum if preferred. Sometimes another small cotton ball is wedged against the first to increase pressure in the inferior meatus. The packing remains in place very well for several days. It is removed by grasping it with forceps or pushing it backward into the nasopharynx.

This method of local packing will effectively control most posterior nosebleeds whether or not the bleeding vessel is seen. The only instances in which I have not been

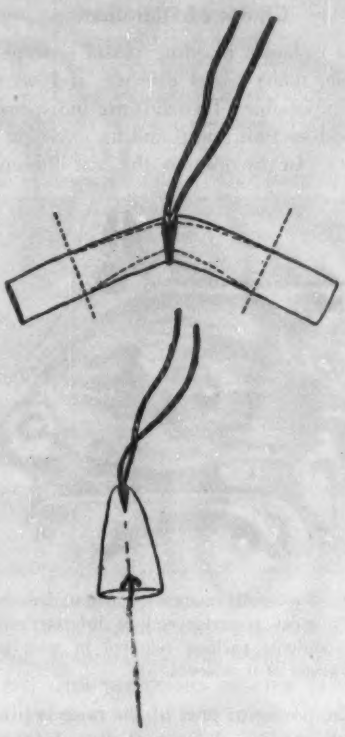

Fig. 1.—Upper figure shows Med tampon unfolded. Original string is in place. Trimming the tampon as shown produces the pack seen in lower figure. An additional string has been sewn to opposite end for easy removal.

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* Another effective pack which meets the above criteria and has the additional advantage of availability is the Med vaginal tampon. With the use of scissors, one-quarter of the length of the tampon is removed from each end and the center portion thinned. With the stout strings readjusted at the center, this tampon makes an excellent postnasal pack which fits one choana only and will not obstruct the Eustachian tube. One additional string can be attached for easy removal (Fig. 1).

able to use this simple method have been when the nasal septum was severely deviated. Once the method is tried the use of the ordinary postnasal pack is discarded by most operators.

Choice of Illumination

To isolate a bleeding vessel is sometimes simple, many times difficult, and occasionally impossible. Two aids are indispensable: a good suction pump and an excellent light source. In my opinion, the best illumination

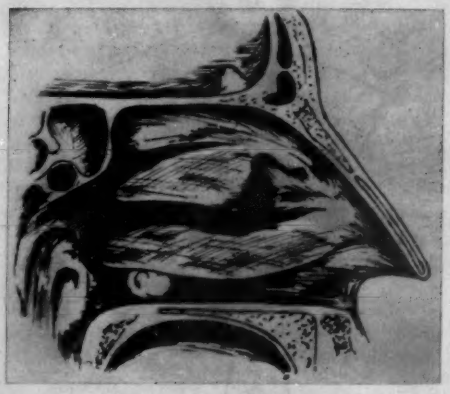

Fig. 2.—Small compressed cotton ball wedged firmly under posterior end of inferior turbinate. No additional packing required in most patients with posterior nosebleeds.

of the posterior part of the nose is provided by the beam of light produced by a 150 watt clear electric light bulb reflecting from a short focal-length headmirror. Illumination of the anterior nasal cavity is less demanding.

With the use of a Weston Electric light meter and a suitable filter, the following maximum readings were obtained for sources of illumination commonly employed by otolaryngologists.

National headlight	50
"Good" light	75
Headmirror, frosted bulb 60W	75
Headmirror, frosted bulb 100W	125
Headmirror, clear bulb (ordinary filament) 150W	
Filament directed sidewise	75
Filament directed at mirror	200
Headmirror, clear bulb (G.E. spotlite) 150W	175
Cameron-Lempert Headlight	275
Storz-Lempert Headlight	300

Thus, the amount of light reflected from the otologist's headmirror is seen to vary directly with wattage and a favorable alignment of the filament. The use of a light bulb with a spotlight-type filament eliminates concern about the filament position, since the bulb is equally brilliant on all sides. Although a frosted bulb and a clear bulb of the same wattage produce approximately equal readings with a light meter, light from the clear bulb focuses more sharply.

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Fibrous Dysplasia of Facial Bones

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In 1938 Lichtenstein coined the phrase "fibrous dysplasia of bone" for a pathologicoanatomical entity which he wished to combine with, on the one hand, or separate, on the other hand, from lesions described in the literature under various designations. Osteodystrophia fibrosa, juvenile Paget's disease, leontiasis ossea, osteitis fibrosa, von Recklinghausen's disease of bones, fibrocystic diseases, and osteitis fibrosa cystica are only a few of the terms involved in the discussion of this problem.

According to Jaffe and Lichtenstein, the process of fibrous dysplasia commences as a fibrous-tissue proliferation within the medulla, replacing marrow, absorbing and replacing the cancellous and cortical bone. Metaplastic bone is laid down in this newly formed fibrous tissue, and occasionally islands of cartilage are developed and cysts may be formed. The most important feature of fibrous dysplasia is its skeletal distribution. The lesion is circumscribed and localized in the interior of the affected bone. It may involve one bone only (monostotic dysplasia) or many areas (polyostotic dysplasia). In the latter instance, usually only one side is involved (arm, leg, or ribs). The area of bone adjoining the focus or foci retains its normal structure. Roentgen studies reveal a translucent circumscribed area of the lesion. Its borders are usually poorly defined in contrast to fibro-osteoma or osteoma (Hobaek). The gross appearance of the lesion may be pale pink or cyanotic. It is often gritty on sectioning as a result of new bone formation (osteoid). In some areas where the connective tissue is more closely interwoven with old metaplastic bone, its consistency may be ivory-hard. In other instances extensive hemorrhage and cyst formation in the bone may be encountered (McCart).

The etiology of fibrous dysplasia apparently is still unsolved. Hematologic study and investigation of renal function fail to yield data indicating a disturbance of mineral metabolism. The blood calcium and phosphorus are normal. The alkaline phosphatase is usually normal; it is slightly elevated when the lesion is coincident with a high level of bone activity. The blood level, however, will seldom exceed 17 or even 20 Bodansky units (Jaffe). There is no increased calciuria or phosphaturia. Calculi of the kidneys have not been reported. Hence, it would not appear to be a metabolic-systemic disease.

Endocrinological factors have been discussed. Weil reported the history of a girl who had spontaneous fracture of a bone combined with precocious puberty (1922). A similar observation was made in 1937 by McCune and Bruch. In 1935 Elmslie was the first to mention a peculiar extraskeletal feature of fibrous dysplasia when he found a nevus on the back of one of his patients. In 1937 Albright and associates reported a series of observations of "osteitis fibrosa disseminata" combined with precocious puberty and hyperpigmentation of the skin. This symptom complex has entered the literature as "Albright's disease." The pigmented areas are near the osseous lesions and apparently have a close relationship. Albright believes that the unilateral occurrence suggests a relation to nerve-root distribution or an embryological defect in the myotomes. Of late, Albright views the disease as a possible disturbance of the hypothalamus. Another etiological

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consideration was noted by Stauffer and co-workers in 1941, when they reported an observation of "polyostotic fibrous dysplasia with cutaneous pigmentation and congenital arterio-venous aneurysma." Close local relationship of all these syndromes led these authors to the conclusion that the bony lesions and pigmentations were the sequence of an abnormal blood supply. Similar opinions referring to this vascular association were previously stressed in reference to Paget's disease (Schmorl).

In 1946 Schlumberger reported 63 observations of "monostotic fibrous dysplasia" in soldiers. No cutaneous pigmentation or other extraosseous abnormalities were found. More than one-third involved the ribs, an observation made previously by Zenker and Konjetzny. The latter authors believed that trauma was often the eliciting factor in their cases of "osteitis fibrosa localisata." Schlumberger studied 11 cases of dysplasia of the facial bones (monostotic): 7 involving the maxilla, 2 the mandible, and 2 the frontal bones. He failed to find these lesions in the deep-seated cavities of the ethmoid or sphenoid sinuses. He concluded that exposure to trauma was also the explanation for this preferential distribution in the skull. Many cases of isolated exostoses and hyperostoses of the facial bones belong in this category. Lesions of endostosis located in the frontal or maxillary sinuses were often considered as a prodromal stage or a modified type of a true osteoma (Birch-Hirschfeld). Schlumberger stated that this reported multiplicity of tumor-like lesions of the sinuses should be listed under the group of "monostotic fibrous dysplasia." Among these we associate the osteoidoma of the frontal sinus (Beck), the "osteoid fibroma with atypical calcification" (Benjamins), osteoma in childhood (Purcell), and some osteofibromas reported by Phemister and Grimson. If we accept Schlumberger's concept, it is debatable whether the ossifying fibromas of the frontal sinus (Woodroff, Ball) and the psammomas of the orbit (Fry and DeLong) should be added to the group of monostotic dysplasia. In 1911 Wagenmann collected a large series of cases of osteoma of the orbit and frontal sinus from the literature and found that in the majority trauma dating from 2 months up to 22 years could be related with the origin of this neoplasia. It seems to be certain that many of these instances would be catalogued today as fibrous dysplasia. Axhausen's "juvenile Paget's of the jaw" (Kiefer-Paget) may also be added to this group.

Brunner, who reported on several personal observations of fibrous dysplasia of the malar, frontal, and maxillary bone, agrees with Schlumberger that the cortical layers of facial bones particularly are involved. He differs, however, with Schlumberger concerning the genesis and vital characteristics of the lesions. Trauma may play an eliciting role in some, but not all, instances. Some lesions develop in early childhood and may prevent the development of the paranasal sinus cavities. Some grow in early adolescence and pass over into a state of inactivity. Others may retain their vital activity for decades, extending into later life; then the typical Paget may coincide with this fibrous dysplasia, and the lesion will not remain unilocular. They may form a thickened and hyperostotic vault of the skull (McCart) or large exostoses of both temples, indicating the early clinical picture of a "leontiasis ossea" (Virchow). They may produce large endostotic buckles in the sinuses and may obstruct the sinal ostia (Brunner). A secondary empyema may then result (Koch, Stamm).

I have attempted to determine whether in previously reported cases of "osteitis fibrosa localisata" of facial bones injury of any kind was mentioned as a possible eliciting factor, so often stressed by Schlumberger. This appears to apply in my investigation of this factor in the cases of Marx (malar bone, frontal sinus), Tonndorf (frontal bone), von Eicken (previous Killian frontal operation, 20 years ago), McCart (frontal and nasal bone), Towson (mastoid), Denstad (hyperostosis of frontal bone), and Wagenmann (old selected cases of possible

fibrous dysplasia of frontal bone). It is, of course, possible that a traumatic factor was responsible in other instances where no mention was made of previous injury of any kind.

The otorhinologist will be especially interested in the genesis and characteristic clinical properties of "monostotic fibrous dysplasia" of the skull. The modern routine roentgen studies so often reveal translucent areas of the skull as an incidental finding.

Eckert-Moebius enumerated (in 1929) 113 osteomata of the frontal sinus. Of these cases, most were found by the pathologists and but a few by the clinicians. By 1940 von Bajkay had noted 403 cases. They have aroused generally little clinical interest. In 1951 Hobaek reported that only 4 of his 24 cases diagnosed by x-ray warranted surgical removal. According to the modern concept, the majority of these osseous translucent lesions might be regrouped into the category of "monostotic fibrous dysplasia." The validity of this regroupment follows, as the differential diagnosis between osteoma or fibro-osteoma, on the one hand, and fibrous dysplasia, on the other hand, cannot be made by the roentgenologist alone. Hobaek states that the osseous tumors have sharply defined border lines, whereas in fibrous dysplasia the borders are ill-defined. Fibro-osteomas show an irregular, slightly marked to average sclerosis; the osteoma demonstrates a usually marked sclerotic shadow, whereas fibrous dysplasia has a homogeneous, less marked translucency. These criteria, however, do not increase or facilitate our understanding in drawing definite conclusions. Even the pathologist is often in doubt as to whether the lesion presented to him is of neoplastic or inflammatory character. Birch-Hirschfeld stated that it is often impossible to determine whether osseous lesions of the skull are due to heteroplasia (tumor) or hyperplasia (inflammation). Borst * held these two differential points to be important. Ribbert believed that there are transitional stages between an exostosis and a true osteoma. Jaffe has lately expressed a similar opinion, when he considered the "monostotic fibrous dysplasia" as a hamartoma, a tumor-like developmental malformation. Ewing observed that the osteomata of the skull were the most peculiar neoplasia. Growth seemed to take place from several centers, with various amounts of vitality. Some centers seem to be silent; others show activity. A similar observation previously was reported by Virchow. Spongy osteomata of the skull became sclerotic after years; later, however, these could return to the previous spongy consistency. This observation seems to be analogous with the modern explanation that an inflammatory process leading to localized fibrous dysplasia has taken place in some types of osteomata (Case 10 of Hobaek, Case 1 of Ball). Schlumberger went even further when he remarked that ossifying or osteogenic fibromas of the skull are but variants of fibrous dysplasia. He considered the monostotic form as an entity to be separated from Jaffe-Lichtenstein's-Albright's polyostotic type. The polyostotic dysplasia is a congenital anomaly, whereas the monostotic type, according to Schlumberger, is a peculiar inflammatory process elicited by a local injury. It begins early in life (often before puberty), pursues a slowly developing course, and often may pass into a quiescent stage in the adult. Fibrous tissue is the primary repair tissue per se; bone is no exception. The development of this "primary osteitis fibrosa" must be assumed to be the unspecific reparative response to various injuries. This tissue presents the main features of the normal histogenesis of cortical bone during the first developmental stage. The second stage of normal histogenesis is the destruction of the fibro-osteoid tissue by osteoclasis and its replacement by mature bone of fine, definitive architecture. In fibrous dysplasia the first stage seems to persist. The primary "osteitis fibrosa" passes into a chronic stage. A local factor is apparently missing which

* Borst, cited by Eckert-Moebius in Denker-Kahler's Handbuch, p. 117.

is needed to achieve definite maturation. Various biological factors seem to participate in order to form a more or less satisfactory substitute for the destroyed predecessor. Hence, the histological picture shows these attempts in the appearance of large calcified areas interwoven with new osteoid bone and more or less fibrous ground substances. Cysts and hemorrhages are other signs of a struggle which has been going on in this atypical osteogenesis and osteoclasis.

Differential Diagnosis

1. Neoplasia.—I have already mentioned that the differentiation between a heteroplastic and homoplastic bone lesion will often present difficulties for the clinician as well as for the pathologist. This applies particularly to skull lesions, where inflammatory interference from the sinuses involved can change the anatomical appearance of the lesion so much that the question "true tumor or monostotic dysplasia" may be a problem. Fibro-osteomas tend to occur in the maxilla and mandible; osteomata favor a frontal-bone localization. Eckert-Moebius could find no report of a fibro-osteoma in the frontal bone (1929). It may, therefore, be justified to consider lesions comprised predominantly of connective tissue in this area of inflammatory origin. Genuine osteomata of the frontal bone have been studied in recent years by Hobaek, Simonton and Medrick, Mesnage and Portmann, Moore, Wild and Heimendinger, and Benton N. Colver. Solitary bone cysts and enchondromas (Dockerty and associates), psammomas of the orbit (Fry and DeLong), hemangiomas of the frontal bone (Holmes, Sweet, and Kelemen), and epidermoid tumor of the frontal tumor (Thacker) are other diagnostic possibilities.

Hobaek believes that the roentgen film can be very helpful in the differentiation between true neoplasia and fibrous dysplasia. In his opinion, the fibro-osteoma of the mandible and maxilla is well defined; the osteoma of the frontal bone is usually lobular, with a translucent zone as a border layer to the surrounding normal bone. The fibrous dysplasia, however, has no sharply defined border lines recalling the old term "hyperostosis."

2. Osteitis Fibrosa Cystica Generalisata.—In 1891 this disease was described by von Recklinghausen. He deserves the credit for having established the disease as an entity. He separated it from osteomalacia, into which category the majority of spontaneous fractures, or pseudofractures, of bone were grouped until that time.

Von Recklinghausen's disease is a metabolic bone disturbance affecting the skeletal frame as well as the extraosseous organs. Tumor or diffuse hyperplasia of the parathyroid glands is the principal etiology (primary hyperparathyroidism). The serum calcium level is usually increased to 10.5 or 11 mg/100 cc. The inorganic phosphorus is reduced to less than 3 mg/100 cc., sometimes even to 2.5 mg. Serum alkaline phosphatase is increased when general bone activity is present. The dysfunction of the parathyroid glands disturbs the normal balance of phosphorus and calcium in the blood. This abnormality leads to resorption of bone in order to maintain calcium balance. Thus, this chain of interplay explains the clinical symptoms of generalized osteitis fibrosa cystica with hypercalciuria, hyperphosphaturia, and polyuria. Gastrointestinal symptoms (anorexia, nausea) and neuromuscular signs (fatigue, loss of muscle tone) are often observed (Kelsey). Removal of the tumor mass or the hyperplastic tissue of the parathyroids will usually correct this disorder of phosphorus-calcium metabolism and lead to a cure of the osseous and accompanying lesions.

Chronic kidney disease (glomerulonephritis, pyelonephritis, obstruction of the urinary tract) may lead to an increased blood-serum level of phosphorus and a lowered calcium level (Albright). This disorder will force the parathyroids to a secondary hyperfunction (secondary hyperparathyroidism). The therapy, of course, must take a general medical approach.

The question "Is there a von Recklinghausen's disease without proving the phosphorus-calcium imbalance in the blood or urine?" has been a difficult one to answer since von Recklinghausen's era. Among his first six cases of osteitis fibrosa, two at least may be classified from the contemporary viewpoint as "fibrous dysplasia" (McCart). Some investigators who became uncertain as to the actual etiological factors have placed the responsibility on the osseous system. Thus the name "osteodystrophia fibrosa" was created (Stenholm, Christeller). Thannhauser, however, considers all forms of fibrous dysplasia as mild expressions of von Recklinghausen's disease. He is one of the few who still adheres to this old thesis.

3. Osteoporosis.—This is also a generalized bone disease, characterized by inadequate function of the osteoblasts in forming sufficient preosteal tissue. The calcium and phosphorus metabolism is not disturbed. Postmenopausal women are chiefly affected. Another cause is malnutrition (lack of vitamin C and protein). In recent years the disease has been observed after overdoses of cortisone (Kelsey). This disease is mentioned here because the skull is often involved. I have seen a patient, aged 62, who presented a history of dizziness, general weakness, tinnitus, and marked perceptive bilateral deafness. Roentgen studies revealed generalized osteoporosis, involving both mastoids and the calvarium. Those decalcified areas are easily distinguished from possible fibrous dysplasia because of the disorganized spread of the lesions and the older age incidence. In some cases, however, when osteoporosis is combined with renal calculi, differentiation from von Recklinghausen's disease may be difficult.

4. Xanthomatosis.—This disease is also called lipoid granulomatosis (Hand-Schüller-Christian disease). It is characterized by unilocular or multilocular lesions of the skeletal system involving especially the skull (myelomata) and is usually combined with cutaneous and mucous-membrane lesions (e. g., xanthelasma of the eyelids, granuloma of the external auditory canal). Its etiology is a disturbed lipoid metabolism, the cause of which is unknown. The histological diagnosis is established when the specific plasma cells can be found in more or less dense connective tissue. Albumin of the Bence-Jones type is occasionally found in the urine. Snapper found plasma cells in two cases diagnosed as "polyostotic fibrous dysplasia with Albright's syndrome." He concluded, therefore, that Albright's disease should not be considered as an entity but as another expression of xanthomatosis (burnt-out cases). Jaffe denies such a possibility.

5. Osteitis Deformans (Paget's Disease).—This disease, described in 1877 by Sir James Paget as a specific localized entity of the skeleton, has given rise to controversial discussion. Von Recklinghausen, Christeller, and Pick † considered this entity as another expression of osteitis fibrosa. They called the typical von Recklinghausen the "hypoostotic" type and the Paget the "hyperostotic" form of the same systemic disease. Schmorl, who originally supported this theory, later came to the conclusion that Paget's disease is an entirely different entity. In 1932 he reported on 190 cases observed through three decades. The vertebral spine and pelvis are the most frequent locations. He believes that excessive tension and strain of muscles and ligaments are the main factors eliciting the lesions. That, of course, would not explain the genesis of Paget's disease of the skull. Pull of muscles may be considered when bilateral deformities of the temples or hyperostotic lesions of the mastoid tip are encountered. Lesions of Paget's type occluding nasal sinuses, encroaching upon the cochlear and vestibular apparatus (Brunner, Grabscheib), point the etiology in another direction. Wear and tear is apparently the main factor in all examples. Paget's is the disease of old people. Koch's case of "leontiasis ossea" with large widened arteries of the scalp is a typical example

† Pick, cited by Schmorl, G.: Arch. path. Anat. 283:694, 1932.

demonstrating that the bony lesions have a close relationship with the adjacent blood supply. A "creeping periosteitis" (Denstad) may be the prodromal stage in those lesions of the cortical bones.

The differentiation of Paget's from fibrous dysplasia may present difficulties arising from the histological picture alone. Studies of the blood chemistry will not aid in the diagnosis, since the calcium-phosphorus and alkaline-phosphatase levels are the same in either case. Age may still be the deciding factor. Fibrous dysplasia is predominantly seen in the young, often before puberty; Paget's is the disease of the older age group.

I have had occasion to observe cases of osseous lesions of the skull which might present differential diagnostic discussion. Hence, their histories and clinical courses and an evaluation in the light of the modern aspects described above are herewith presented.

Report of Cases

CASE 1.—A 30-year-old white man. Father had syndactylia of the right third and fourth fingers and was a stammerer. Patient was the youngest of nine children. Upper part of the head was unusually large at age 3 (bitemporal bony exostoses?). He stammered at age 5 or 6. Jaw and chin became larger at age 10. Patient never had a normal dental bite and no development of permanent teeth. His scholastic performance was poor, but he could read and write. No abnormal sexual behavior was noted.

Physical Examination revealed a medium-sized, normally developed white man. The appearance of the head, however, recalled at once "leontiasis ossea Virchow." Both temples showed large protuberances; eyes were small, lying deep in their sockets. Both mandibles had large exostotic buckles. Above the chin there was a large ball-like bony formation emerging from the lower alveolar process. Mouth could not be closed. Cavity of mouth presented an unusual sight. Tongue could not be seen. When patient was requested to stick out the tongue, a very thin, band-like structure could be observed. Floor and roof of mouth showed large exostotic masses. They narrowed not only the oral cavity but also the entrance into the hypopharynx. Laryngoscopic picture was poor because exostotic masses occluded the laryngeal entrance (Fig. 1).

Fig. 1 (Case 1)

Nose: very small. Ears: normal.

Lungs, heart, abdomen, and lower extremities: normal.

Arms: normal. Fingers: End phalanges were thickened and bulbous.

Nervous system: essentially normal.

Roentgen Studies.—Many areas of diffuse translucencies were seen in the skull. There was a dense, well-limited area in the mandible; its appearance suggested a tumor (odontoma?). Roentgen film of the fingers did not reveal proof that there was abnormal osseous development (osteitis fibrosa?).

Laboratory Studies.—Normal blood cell count and normal urinalysis; serum calcium was 10.5 mg/100 cc. (slightly below normal).

Treatment.—Patient came to the clinic (University Hospital for Ear, Nose and Throat Diseases, Muenster, Germany) in June, 1925, because of difficulty in swallowing and fear of choking for the past several months. It was decided to remove the bony masses in several stages.

First operation (Prof. H. Marx), June 23, 1925: Under general anesthesia the enlarged bony mass of the lower alveolar process was removed via an external incision. Several teeth were found imbedded in the bony lesions. Bone was soft and very hemorrhagic.

Second operation, July 8, 1925: Exostotic masses of the floor and roof of the mouth were removed (intraoral approach) with gouges and rongeurs. Hemorrhage was again rather severe.

Third operation, July 27, 1925: The large bony masses of both temples were removed with gouges and rongeur. Bone was gritty. Bleeding was not as severe as in previous operations.

Fourth operation, Aug. 19, 1925: A tracheotomy was done in order to perform the operative procedures in the mouth with a greater degree of safety. Attempt was made to excise the more deeply situated lesion in order to allow more room for the tongue and the soft palate. This time the hemorrhage was so severe that the operation had to be interrupted. During the next few months the patient received several blood transfusions and was prepared for the next operation.

Fifth operation, Jan. 20, 1926: Now the intraoral masses, including the round ball (tumor), were removed with burrs and rongeurs. For the first time the uvula could be seen and entrance to the larynx was freed.

Postoperative Course.—The patient recovered satisfactorily and was discharged from the hospital in March, 1926. He was seen again, in December, 1926, in good condition. The tongue was still atrophic but had regained semblance of natural form and size. No regrowth was noted at that time. The histology of the bony masses removed showed various pathological features. The tumor was an odontoma; the bleeding areas showed osteitis fibrosa interwoven with large blood vessels (Fig. 2). Other areas, especially the temple, revealed bone characterized by dense connective tissue (Fig. 3).

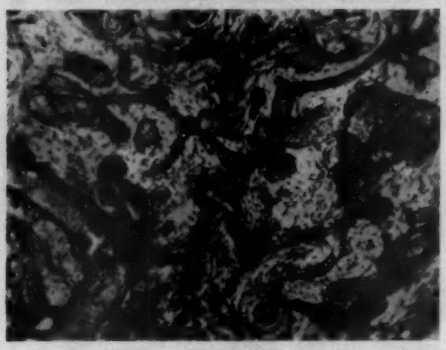

Fig. 2 (Case 1)

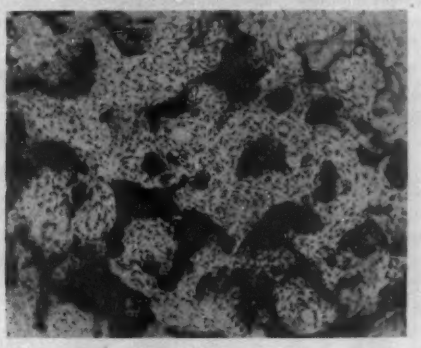

Fig. 3 (Case 1)

Conclusions.—Marx reported this case in 1926 under the diagnosis "leontiasis ossea." History, youth, and the presence of a bone tumor in the mandible (odontoma) pointed to a congenital defect leading to this specific bony lesion of the skull which Marx considered as a "Recklinghausen osteitis fibrosa." This case presented, in his opinion, an example of "leontiasis ossea vera Virchow," in contrast to Paget's disease of the skull leading to the "leontiasis ossea spuria." The skull in this case was very similar to a skull in a case reported by Bickerstadt (Dupuytren Museum in Paris). The lower parts of the skull were especially involved, whereas the classical case of Paget's "leontiasis spuria" reported by Koch occurred in an arteriosclerotic old woman with the typical exostotic protuberances of both temples. Von Recklinghausen's disease apparently attacks the facial bones, whereas Paget's disease attacks the calvarium.

Comment.—This patient was under my observation during my residency at Professor Marx's Clinic, 30 years ago. An unforgettable impression elicited by this unusual clinical specimen has remained until today. The question asked by our group of graduate students was, "Why has this congenital abnormality affected the skull only, and why was the histological picture of such a peculiar variety?" True tumor (odontoma), in the facial bones, and fibrous osteitis with an abundance of fibrous ground substance in the temple areas (Geflechtknochen) were the main histological data found. Marx's conclusion that we were dealing with a form of von Recklinghausen's osteitis fibrosa was apparently in agreement with the general opinion of that time. In the light of modern viewpoints on these bony lesions, it may be questionable to maintain this diagnosis. Von Recklinghausen's disease is connected with a metabolic calcium and phosphorus disorder, not proved in this case. Hence I am inclined to place this case in the group "polyostotic fibrous dysplasia." Figure 3 resembles Figure 5 of Case 2, where the diagnosis "fibrous dysplasia" was made by several pathologists. Figure 2 might present a type of vascular fibrous dysplasia. Hemorrhagic fibrous dysplasia has been mentioned in the literature (McCart). Various biological forces seem to work in order to create substitutes for bone which cannot, for reasons unknown, reach full maturity. Hence, we meet these various expressions of these attempts at regeneration and repair.

Case 2.—A 65-year-old white man, German im-

migrant, consulted me Jan. 12, 1952. He was referred by his family physician, who had treated him over a period of several weeks for a "sinus infection." The patient was not too concerned about his nasal symptoms. These started after an automobile accident in 1932, in which a severe injury of the left eye occurred. A severe infection followed, and the left orbit was enucleated. His insurance company granted him a set of glass eye prostheses and a yearly vacation to a German spa in order to have his "sinusitis" treated with saline and eucalyptus inhalation. After his emigration in 1939 he was under the regular care of his family physician.

On this occasion his nasal "catarrh" did not clear after routine treatment. For the past six weeks he complained of headaches over the left eyebrow and the left temple. No acetylsalicylic acid (aspirin) or similar analgesic gave relief. Therefore a roentgen study of the sinuses was performed. The report was as follows:

Frontals: The sinuses were symmetrically well developed. There was a moderate-sized, fairly well circumscribed opacity, measuring about 2 by 3 cm., in the interior portion of the left frontal sinus having the configuration of a large osteoma. The examination was otherwise negative.

Ethmoids: well developed and well aerated bilaterally.

Maxillaries: fairly well developed and slight decrease in radiolucency bilaterally, suggesting a slight degree of mucosal thickening.

Sphenoids: well developed and well aerated bilaterally.

Summary: The examination of the paranasal sinuses demonstrated a large osteoma in the left frontal sinus and a slight degree of mucosal thickening of both antra.

Physical Examination revealed a medium-sized, normally developed white man.

Eyes: right eye normal, left eye replaced by a glass prosthesis.

Nose and sinuses: There was pain over the left eyebrow on palpitation, but there was no swelling and no tumefaction. There was some yellow secretion in the left middle meatus.

Nasopharynx: diffuse mucoid secretion along the roof.

Pharynx and larynx: essentially normal.

Ears: old mastoid scar, left; otherwise normal.

Skull and neck: normal.

Chest was well formed; lungs and heart were normal. Blood pressure was 140/95. The abdomen was soft and obese. No masses or viscera were palpable. The extremities were negative.

Laboratory Studies.—Urinalysis and hemogram were within normal limits. Wassermann-Kahn was negative. Blood chemistry: sugar, 83 mg/100 cc.; urea nitrogen, 20 mg/100 cc.; calcium, 12 mg/100 cc.; phosphorus, 4 mg/100 cc.; alkaline phosphatase, 3.6 Bodansky units. Roentgen studies of chest, both upper and lower extremities, pelvis, and skull did not reveal any bony lesions.

Operation under local anesthesia. An arch-like incision was made 2 mm. below and parallel to the entire length of the left eyebrow and continued as far as the root of the nose. The mucoperiosteum was dissected with a sharp elevator from the frontal sinus floor. Skin and mucoperiosteal flap were pushed down and held with Halle's eyebulb protector. The inferior bony wall of the frontal sinus was removed with gouges and rongeurs to the extent of two-thirds of the anterior aspect. This part was very thin and partly adherent with bony tissue of gritty consistency and grayish color. Further inspection revealed that these bony masses were adherent to the anterior and portions of the posterior bony wall of the frontal sinus. It was of small walnut size, had several dents, had a smooth surface, and was very gritty as osteoid tissue. Attempt was made to shell out the mass in one piece. That, however, was met with difficulty. Hence it was removed piecemeal with gouges, rongeur, and curettes. Some pieces were gritty as absorbable gelatin sponge (Gelfoam); other portions looked like bony shells. The major portion of the frontal aspect of the frontonasal duct was closed with this bony mass. After removal of these bony lesions, yellow fetid pus emerged under pressure from the superior areas of the frontal sinus. There was a large empyema filling up the huge frontal sinus cavity. The mucosa was thickened and covered with thick granulations. The wound was washed with saline and hydrogen peroxide. The incision was closed with interrupted nonabsorbable surgical (silk) sutures with the exception of the lowest point, where a small piece of iodoform gauze was left for drainage. Another piece of iodoform gauze was introduced from the frontal sinus through the nasofrontal duct into the left nasal cavity.

Laboratory Studies.—Staphylococci and B. pyocyaneus.

Postoperative Course was uneventful. Packs were removed after two days. The wound closed per primam intentionem. Under antibiotic therapy the nasal secretion subsided after three and one-half weeks.

Aug. 23, 1952: Reexamination revealed complete cure. Roentgen studies did not show evidence of a recurrence of new bony lesions.

Nov. 15, 1954: Patient felt fine, had no complaints. There was no intranasal evidence of a flare-up of the old "sinus infection."

Figure 4 shows the preoperative roentgen films.

Figure 5 shows the patient after operation.

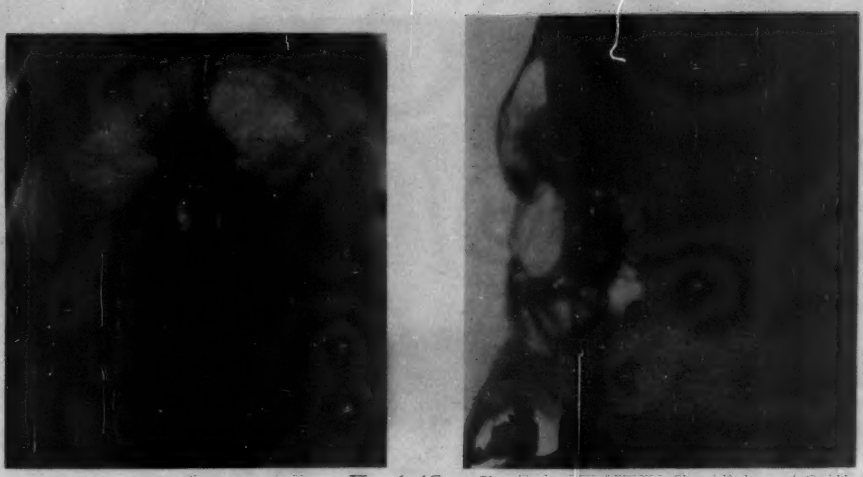

Fig. 4 (Case 2)

Fig. 5 (Case 2)

Figure 6 shows the histological picture which gave rise to discussion among the pathologists studying the slides (fibrous dysplasia, ossifying fibroma, Paget's disease, hyperostosis, osteoma).

Comment.—The outstanding clinical feature of this case is the recurrent infection of the frontal sinus for the past 20 years. This condition was compensated by the patient's insurance company as a sequela of an automobile accident in which the left eye was so severely injured that the eyeball had to be enucleated. There is also no doubt that the bony lesion in the left frontal sinus was elicited directly or indirectly by the previous injury, but it is difficult to say whether the bony growth obstructing the frontonasal duct was responsible for the

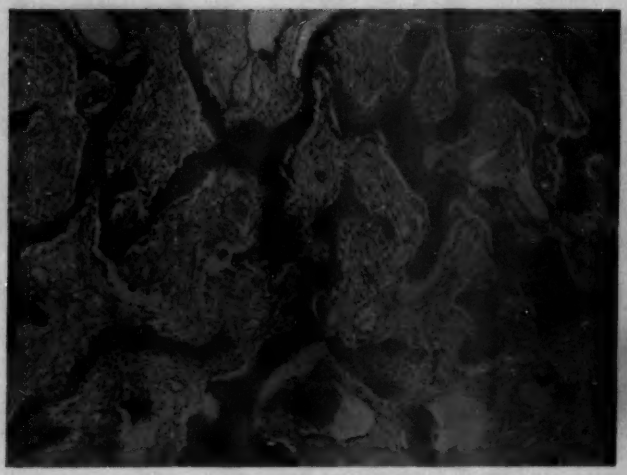

Fig. 6 (Case 2)

chronic empyema found or that a chronic infection was present before the bony anomaly had been established. My first impression during the time of operation was that I was dealing with an old post-traumatic hematoma which had developed within the course of the two decades elapsing after the accident. The histology, however, gave no support to this assumption. A type of Paget's lesion was a diagnostic possibility because of the patient's age and the slightly increased calcium level in the blood. Considering the preceding injury, a hyperostosis frontalis circumscripta presenting itself as "monostotic fibrous dysplasia" should be considered more probable from the clinical viewpoint. I would, however, be inclined to agree with the pathologist, who denied the possibility of a true tumor (ossifying fibroma or real osteoma), because no signs of heteroplastic growth could be found.

CASE 3 (courtesy of Dr. M. S. Ersner).—A man aged 49 first consulted in September, 1947, at which time he complained of deafness in the left ear.

Historical Data.—Scarlet fever at age 7, for which he was hospitalized. Upon discharge, swelling was noted over the zygoma. At that time a tooth was also extracted, resulting in marked edema of the jaw. The patient had enjoyed good health with the exception of a swelling over the right side of his face for the past 32 years (Fig. 7). A plastic surgeon was consulted at that time and x-rays of the skull and face were made. He decided not to institute any further operative procedures.

Examination.—Aural examination in September, 1947, revealed the left external auditory canal to be filled with what appeared to be an exostosis. Upon palpation, a hard mass was felt, completely filling the external auditory canal and so interfering with the transmission of sound due to occlusion of the canal.

Roentgen Studies revealed the following:

Skull, sinuses, and mastoids: The skull, including the facial bones, was badly deformed as a result of fibrous dysplasia. The disease was manifested in the right side of the facial region, where it involved the maxilla, nasal bones, orbit, frontal sinus, and adjacent portions of the skull (Fig. 8). A large bony overgrowth was visualized in the left temporal and parietal regions, and there were somewhat cystic expressions of the disease elsewhere, particularly in the outer table of the right parietal bone (Fig. 9). The mandible on the right side was greatly enlarged, and the petrous pyramids were enlarged and denser than normal (Fig. 10). It seems quite likely that the complaint of deafness was due to the marked bony overgrowth as a result of the fibrous dysplasia.

Conclusions: This examination revealed marked deformity of the skull and facial bones and also the mandible as a result of fibrous dysplasia. This is the type of case that was formerly diagnosed as leontiasis ossea.

Long bones, dorsolumbar spine, and pelvis: There was evidence of the disease in the skeleton, with maximum manifestations in the humeri. Both humeri (Fig. 11) were expanded in the region of their shafts, where the medullary cavity was unusually radiolucent and the cortex was thin. There was evidence of the disease in the right scapula, in the lumbar spine (where cystic areas were visualized in the bodies of the second and third lumbar vertebrae), and also in the pedicles of the

sixth and perhaps seventh dorsal bodies. No doubt there were other less evident manifestations of the disease in the skeleton that might have been discovered by a painstaking study of all parts.

Conclusions: This examination revealed manifestations of fibrous dysplasia in the skeleton of a patient who had marked deformity of the skull and facial bones as a result of the disease.

Treatment.—Patient was next seen on Nov. 9, 1954 (seven years later), and he complained of a constant "gnawing pain" in the left ear. The canal was still filled with the hard mass. He returned on Nov. 11, 1954 (two days later), and examination disclosed that the skin of the external auditory canal was broken and solid grayish-colored tissue was protruding into the canal. Several pieces of the size of a pea and which felt like watermelon rind were removed and sent to the laboratory for histological diagnosis. Pathological report was "keratin from the external ear." There was slight otorrhea from the left ear for one week. A small perforation was visible in the anterior quadrant of the tympanic membrane. Hearing has improved because there is ample room in the external auditory canal. Audiometric tests disclosed a conductive deafness in the left ear. Hearing in the right ear is normal.

Patient was seen once more, in January, 1955. The perforation was healed, and the right ear was dry. Hearing is good.

Fig. 7 (Case 3)

Examination on March 15, 1955.—No change, no complaints.

Blood studies: serum calcium, 11.3 mg/100 cc.; serum phosphorus, 2.0 mg/100 cc.; alkaline phosphatase, 5.4 mg/100 cc.

Urine studies: calcium, 96 mg/24-hour specimen; phosphorus, 0.9 gm/24-hour specimen. Volume of specimen: 825 cc.

Reexamination on May 5, 1955.—A salivary calculus was removed from the right parotid duct. It was yellowish in color, measuring over-all 7 by 3 mm. Sections of decalcified calculus showed homogenous pink-staining material forming the matrix for the mineral that had been dissolved out. In addition, there were areas of exudate consisting of many polymorphonuclear leucocytes and a few mononuclear cells, apparently adherent to the surface of the calculus.

Comment.—This patient presented several differential-diagnostic problems:

1. The exostotic lesions of the facial bones, the os tympanicum, and the upper spine in the middle-aged man should direct our attention to a possible "Paget." In former decades the diagnosis "leontiasis ossea" would have been the first thought.

Fig. 8 (Case 3)

Fig. 9 (Case 3).—Roentgenogram of left temporal bone.

Fig. 10 (Case 3).—Lesions of right petrous pyramid and right mandible.

The history, however, revealed an early start of the facial deformities (in the early years of the third decade). Paget's disease, however, is generally restricted to the older people.

2. The various circumscribed areas of decalcification with cystic degeneration in several vertebrae and the long bones of the extremities present the typical picture of a "polyostotic fibrous dysplasia." The roentgenologist in charge had no doubt about this diagnosis.

3. The blood chemistry of this patient, however, revealed a disturbed mineral metabolism. The content of calcium and alkaline phosphatase in the blood serum was increased, and the curve of phosphorus in the blood was below the level of the normal state. This abnormal calcium-phosphorus metabolism combined with pathological bone activity is a characteristic sign of hyperparathyroidism (Recklinghausen's disease).

Hence, we would be inclined to put this case into the group of metabolic bone diseases. Further clinical observations may answer the question whether we have to deal here with a primary hyperparathyroidism (tumor, hypertrophy) or a secondary hyperparathyroidism (lesions of kidney, liver, colon).

Summary

Fibrous dysplasia of the facial bones is described. Its monostotic and polyostotic forms, with and without Albright's syndromes, are discussed. The differential diagnostic points characterizing Recklinghausen's osteitis fibrosa cystica, osteoporosis, xanthomatosis, Paget's osteitis deformans, and osseous neoplasia are enumerated.

History and clinical course of three cases are reported. Case 1 was a young man of 31 who presented the clinical picture of "leontiasis ossea vera Virchow." Case 2

Fig. 11 (Case 3).—Roentgenogram of left humerus.

was an elderly man of 65 who presented an endostotic lesion in the left frontal sinus combined with an old empyema. Case 3 was a middle-aged man, 49, who manifested diffuse evidence of fibrous dysplasia combined with the skull pathology of leontiasis ossea, probably similar to that of Case 1. Case 1 had a congenital and Case 2 an acquired (accident) etiology. Case 3 presented an etiological problem that will remain unsolved until further clinical data can be obtained.

Tabor Medical Building (41).

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Improvement of Hearing in Otosclerosis by Means of Stapes-Mobilization Operation

Report of Results and Experiences

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and
BERNARD J. RONIS, M.D., Philadelphia

An important advance in otologic surgery was developed as the result of Rosen's stapes-mobilization operation. This operation has been adequately described by Rosen in various publications.* Other reports have been made by Meurman and Meurman,[9] Scheer,† and Goodhill.[12]

In these articles, the historical aspects of this procedure are discussed. Rosen has operated upon many patients within the past three years, and additional reports are constantly appearing from other parts of the world. We should like to add our experiences, which indicate that many patients deafened by otosclerosis can have their hearing restored to practical and even normal levels as the result of this operation.

Much progress has been made in a short time. It is true there are unanswered problems, but in time these may be solved. Our experience covers a period of approximately 18 months. During this time considerable effort was expended at first in observation and cadaver dissection. Our first operations were performed in January, 1955. This present report concerns our experience with 139 patients, on whom 161 operations were performed (Table 1). These results will be reported jointly, since we feel that each operator has attained a similar degree of proficiency. Our early efforts run a course that will probably be experienced by many. While a degree of proficiency can be obtained with cadaver practice, the feel of mobilizing the stapes can only be accomplished on the living patient with otosclerosis. Only rarely will the cadaver specimen give the opportunity of mobilizing a fixed stapes. At first the results may be discouraging, and, due to lack of experience, complete mobilization may not be obtained, the crura may be fractured, or the incus may be disarticulated. It would probably be best if each surgeon could perform his first operations with an experienced surgeon present to guide him through the first difficulties. The presence of blood in the external auditory canal and middle ear is annoying at first and must be overcome. However, most of these problems are not insurmountable. In our group at Temple University, there are at least five younger associates acquiring this experience under our guidance, who have done at least 75 operations with a comparable percentage of good results.

TABLE 1.—*Results of Stapes Mobilization in One Hundred Thirty-Nine Patients*

Total patients	139
Total operations	161
Patients improved	65 (47%)
Successful operations	77 (48%)
Patients not improved	74 (53%)
Unsuccessful operations	84 (52%)

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From the Department of Otorhinology, Temple University Medical Center.

* References 1-8.

† References 10 and 11.

Selection of Patients

The best results are obtained in the ideal cases of otosclerosis. Here, one should have the bone conduction above the 30 db. level, preferably from 0-15 db., and a wide air-bone gap of 20-30 db. The air-conduction curve will vary from 30-50 db. The speech-reception level should be comparable to the pure-tone threshold, and a good score for the PB-50 discrimination tests should be present. All of our patients were tested in a sound-treated room with a low ambient noise level, and with standard audiometric equipment which is calibrated frequently. The speech tests were done with recorded Spondee and PB-50 lists prepared by the Technisonic Institute. The tests were made by well-trained technicians with long experience in audiometric measurement.

The term clinical otosclerosis has been used for many years in referring to the patient with a presumptive diagnosis of otosclerosis. This term was established because the final diagnosis was made at fenestration surgery, when the stapes could be palpated for the degree of fixation. As a result of our experiences with the stapes mobilization, several things have been determined:

1. The diagnosis of otosclerosis can be made clinically and audiometrically. In every patient in whom we suspected otosclerosis, a fixation of the stapes footplate was found on palpation at the time of operation.

2. The stapes-mobilization technique gives further evidence when the palpation is accomplished, although this is not needed now.

3. The degree of stapes fixation cannot be predicted by the preoperative audiologic survey.

4. There has been no correlation in our series between the degree of fixation, the degree of deafness, the length of time the deafness existed, and the amount or pressure or pull needed to obtain mobilization.

5. At the present time, the successful candidate cannot be predicted preoperatively.

6. The amount of hearing improvement cannot be predicted preoperatively.

The age of the patient does not predetermine the degree of fixation or the ultimate end-result. Our youngest patient was aged 13 years, and the oldest 60 plus (Tables 2 and 3). Good results are obtainable despite the years of deafness. If the preoperative audiological survey indicates good cochlear nerve reserve by the presence of a wide air-bone gap, a good result can be anticipated. A restoration of air-borne hearing can occur to the level of the bone-conduction level. That is, the air-bone gap is obliterated. This ideal situation results in normal hearing and is achieved in approximately 18% of the cases.

In this first series of operations patients with every degree of deafness due to oto-

TABLE 2.—*Duration of Deafness*

Years	Successful	Unsuccessful
1-5	15	16
5-10	19	13
10-15	15	20
15-20	10	16
20-25	2	5
25-30	2	3
30-35	1	1
35-40	1	0
Total	65	74

TABLE 3.—*Age of Patients*

Age	Successful	Unsuccessful
10-15	1	0
15-20	0	0
20-25	12	9
25-30	14	8
30-35	9	16
35-40	10	10
40-45	13	19
45-50	2	3
50-55	2	5
55-60	2	3
60-65	0	1
Total	65	74

sclerosis were operated upon in order to explore the possibilities of this new procedure. In some of these patients with a severe degree of deafness due to otosclerosis, who had accompanying cochlear-nerve involvement of varying degree (as long as an air-bone gap existed), operations were done in order to see if improvement would occur. It was hoped that if the air-conduction curve could be raised to the level of the bone-conduction curve, i.e., if the air-bone gap closed, the patient would have an improvement of hearing. Thus the patient could achieve better results with a hearing aid, even though he would not have practical serviceable hearing.

We also selected patients for surgery with early otosclerosis. These patients had a hearing loss of 30 db. or less. The stapes-mobilization procedure makes it possible to operate on patients much earlier than we did with other surgical procedures. This subject was recently discussed by Rosen and Bergman.[8]

Another important surgical possibility is those patients with unilateral deafness. These were rarely operated on in the past. With the stapes-mobilization procedure there is usually no hesitation on the part of the patient or the surgeon to attempt to improve the hearing.

There were also patients with successful fenestrations in one ear and in whom the opposite ear was done by the stapes technique with resultant bilateral auditory rehabilitation.

Bilateral operations were done on 14 patients; in 10 patients successful results were achieved bilaterally. This in itself opens a new era in otological surgery, to restore patients to practical hearing in both ears (Table 4).

These various categories of patients will be defined and illustrated.

TABLE 4.—*Results of Operations*

	Successful	Unsuccessful
Number of patients	65	74
Number of operations	77	84
Revisions	2	6
Bilateral cases	10	4

Preoperative and Postoperative Treatment

Our patients are hospitalized for 24 hours. The patients are admitted on the morning of operation. The patients are given pentobarbital (Nembutal), 3 grains (200 mg.), about 60 minutes preoperatively. The patients are briefed as to the expected surgery, and are cooperative. Heavy sedation is avoided because we like to be able to talk to the patient and test his response to speech and pure-tone audiometry. Postoperatively, the patients are immediately ambulatory and require only mild analgesic sedation. The patient is discharged on the morning of the next day. Each patient is given an antibiotic for a five-day period postoperatively. We have been using tetracycline (Tetracyn), 250 mg., every six hours. There were only six patients with marked nystagmus and vertigo immediately postoperatively. These patients were given cyclizine lactate (Marezine), 1 cc., intramuscularly. In all patients, the vertigo subsided within an hour or two and did not recur. This nystagmus was probably due to the sudden mobilization of the labyrinthine fluids. The fact that it subsided immediately would speak against a labyrinthosis.

Operative Technique and Instrumentation

The technique is essentially that acquired from Dr. Samuel Rosen, with minor personal variations. No preoperative preparation is necessary. The ear and postauricular region are cleansed with alcohol and ether. The auricle and ear canal are then The patient is draped so that only the ear is exposed. The drapes are so fixed over a Mayo stand that the patient can breathe comfortably. Aspiration is obtained by using 23-gauge or 20-gauge filled with aqueous benzalkonium (Zephiran), 1:3000, which is allowed to remain for 10 minutes. spinal needles as suction tips. The anesthetic solution is 2% lidocaine (Xylocaine) (3 cc., to which is added 1 cc. of epinephrine, 1:1000). Usually about 1 cc. of the solution is needed. The injection is made into the external auditory canal with the use of a 25-gauge needle. The ear spec-

ulum is pressed against the membranous canal. This forms a ledge, into which the needle is inserted. A small wheal is raised, and the point of the needle is directed toward the osseous canal. The entire canal is circularized in this manner with no attempt to inject the osseous canal at this time. The skin lining of the osseous canal is very thin and insertion of the needle directly would tear the skin of the canal. After the membranous canal is circularized with the anesthetic solution, the injections are repeated. By this time the skin is thickened and a fine beveled needle (25-gauge on a tuberculin syringe) is easily inserted into the skin lining of the osseous canal. The injection is made slowly, in small amounts, and the operator can watch the solution spread into the skin of the osseous canal and over the drum membrane. Some of the solution probably gets into the middle ear and anesthetizes the mucosal surface.

The operation is done through an ear speculum, with the surgeon wearing a Zeiss binocular loupe, which gives × 2.5 magnification. Some operations were done with a Zeiss binocular operating microscope, with × 6 magnification. The middle ear is inspected with the Zeiss operating binocular microscope with the use of magnification up to × 24.

The instruments used are those designed by Rosen. We have found that the Rosen curette, originally designed to remove portions of the bony canal, works well as a knife when its edge is sharpened. The curved edge seems to work better and gives less pulling and tearing of the skin than a pointed triangular knife. The curette is also used as an elevator and can at times be employed as a mobilizer. The incision is started in the posterior-superior canal wall about 4-6 mm. from the drum edge. In the left ear the incision moves in a clockwise direction, and in the right ear in a counterclockwise direction. The incision starts at 12 o'clock, with the use of the short process of the malleus to denote 12 o'clock. The incision is made in small steps, making each cut through the skin and into the osseous canal. Before any attempt is made to dissect the flap, be sure the knife can run all around the entire incision and bite into the bony ear canal. Any shreads of the skin the knife does not separate can be cut with a small iris scissors or with Bellucci's scissors. When this is complete, the dissection begins. It is best to start in the posterior-superior quadrant. The skin is thicker here and is more easily elevated; also, it is easier to enter the middle ear at this point than below the notch of Rivinus, where the fibrous annulus fits into the sulcus tympanicus. The dissection proceeds around the entire incision to 5 o'clock in doing the right ear, and to 7 o'clock in the left ear. When the region of the sulcus is reached, one can feel the dissecting instrument dip into the sulcus and lift the fibrous annulus out of its bed. The dissection then proceeds until the end of the osseous canal, where the middle ear is entered. Here a feeling is obtained as though one is perforating something, and then the dissector drops into a cavity. Unless this feeling is obtained, the drum will not be free and cannot be lifted. It is wise to carry out this dissection by touch, not to stop to aspirate or mop out the blood, since this seems to prolong the bleeding. If the surgeon moves along, by the time the middle ear is reached most of the bleeding stops. When the dissection is completed, the blood is aspirated and the area mopped with small cotton pellets soaked in the epinephrine solution (1:1000). The mucosa of the middle ear is visualized as a separate layer, and upon eversion the promontory can be seen. This is usually blanched from the anesthetic solution and looks very white. With the use of a very fine elevator, the tympanum is lifted from the canal from 12 to 7 o'clock, or 12 to 5 o'clock, and the eardrum easily folds on itself. The chorda tympani nerve is often encountered but seldom has to be disturbed, since it rests in the bony ledge of the canal. At times it must be displaced from the line of vision. It is best to avoid trauma to the nerve, since this may result in a disturbance of taste that will last for some weeks. When the middle ear is visible, the ossicular chain is easily identified. With the use of a fine probe, the incus and stapes are palpated. At times it is necessary to remove a small amount of the bony rim of the osseous canal with small curettes. Those devised by House are very efficient. Usually if the stapes tendon can be visualized, mobilization can be attempted without curettage.

In some patients palpation of the incudostapedial joint as an exploratory procedure has resulted in stapes mobilization, with sudden and dramatic hearing improvement. This technique of initial pressure palpation in an attempt to mobilize the fixed stapedial footplate has become a routine procedure in our work. If mobilization by this means cannot be effected, then the instrumentation with the use of Rosen's mobilizer is used. Recently, we have been successful in mobilization of fixed stapes by percussion of the long crus of the incus at the joint, using a specially devised probe which straddles the incus or the air hammer (dental amalgam condensing apparatus). The mobilizer of Rosen is used as follows:

We place the instrument on the stapes neck, just below the incudostapedial articulation, rather than bring the mobilizer up along the crura of the stapes. The pull is made in the direction of the stapes tendon. This is a steady lifting motion and a pulling force posteriorly in the direction of the stapes tendon, and it is necessary to imagine the posterior lip of the stapes to be a hinge. Sometimes very light pressure will effect mobilization,

but very heavy pressure may be needed. At times, one has to barely touch the stapes and it begins to move freely. At any rate, one should pull as hard as necessary to get mobilization. When movement occurs, there is a feeling as though something has been torn away. When an audible click is heard, this may be an ominous sign. It may mean fracture of the stapes crura. As soon as the stapes is mobilized, there will usually result an immediate improvement in hearing. The patient will exclaim that he hears something give or snap, describing it as a pistol shot in the ear. The incus and stapes are palpated, and the free movement of the incudostapedial joint will occur, which is almost like a cork bobbing in water. The stapes will be seen to move with each palpating movement of the joint. The patient, when interrogated, will say that he hears a grating sound as the stapes is pushed in and out of the oval window. At this time, the hearing can be tested with words or pure tones. When complete mobilization has occurred, the hearing improvement is phenomenal and will often be maintained from that moment on, despite blood in the middle ear, edema, packing, and dressings.

The audiogram of Case 1 (Fig. 1) illustrates this well.

CASE 1.—A 48-year-old woman, employed as a stenographer, was noticing an increasing hearing loss. Deafness first developed at the age of 18 with bilateral tinnitus. She heard well on the telephone and upon using the Dictaphone. She heard better in noisy places. Her father and sister also

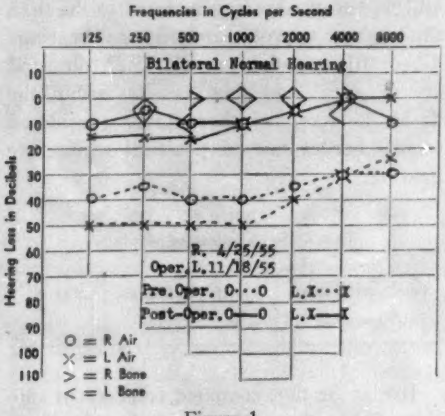

Figure 1

had otosclerosis. Our study revealed bilateral otosclerosis, a wide air-bone gap, normal bone conduction by audiometric measurement, and prolonged bone conduction with the tuning forks. The first operation was performed on April 25, 1955. The stapes was mobilized by easy pressure, and hearing became keen for the spoken and whispered voice. The ear canal was packed, and good hearing persisted from the moment of mobilization and is still present after more than one year. The right ear was operated on Nov. 18, 1955, with the same experience.

At the time of this preliminary report, we are not able to state just how much reliability can be placed on pure-tone tests or speech audiometry when they are done on a premedicated, tense person on the operating table. These factors are being studied and will be the subject of a later report. One may have to depend on calibrated speech tests. The final test, and most important, is whether the hearing improvement is maintained some weeks postoperatively. This really tells us whether the patient has had a good result or not. It is this phase of the operation that needs the most study. There is no doubt that hearing improvement can be obtained in many patients, but how to be sure at the operating table is the problem. Sometimes the noise in the operating room, the anxiety of the patient to hear, and the operator's desire for success make the testing unreliable. The surgeon's whisper may actually be much louder in his anxiety to convince himself or the patient that a good result is being obtained.

We have noted that there are several ways to check on mobility of the ossicular chain:

1. Observe the movement of the stapes tendon. When fixed, it is rigid. When the stapes is mobile, the tendon wrinkles.

2. Press on the incus and observe the stapes bobbing in and out.

3. If a drop of fluid or blood is in the round-window niche, a reflex movement can be observed there.

4. Press on the handle of the malleus in the inner aspect of the drum and watch the movement of the ossicular chain.

5. Palpate the crura of the stapes to determine if a fracture has occurred.

6. Observe and probe the incudostapedial articulation to make sure a separation did not occur.

When manipulation is completed, the

drum is replaced, the skin smoothed into position, and the incision closed by apposition of flaps. The line of incision is covered with a layer of silk or nylon, and small cotton pellets are used to pack the ear. A small gauze dressing held by adhesive strips completes the operation. The pack is removed on the fifth or sixth postoperative day. In some cases, it will be seen that the canal and the drum are almost healed. In other cases the drum may be ecchymotic and swollen for some days. No treatment is given after the pack is removed. In the very successful cases, the hearing improvement can be maintained from the moment of mobilization. Sometimes the patient will hear well for several hours, and then the hearing becomes diminished due to edema, blood, and packing. This will often return on the fifth day when the pack is removed. In some cases the hearing result will not occur until sometime between the fifth day and third week. Rarely will any improvement occur if it is not present by this time. Occasionally some improvement may continue up to the sixth week.

We usually wait eight weeks before operating upon the opposite ear. The hearing is tested audiometrically on the fifth day, during the third week, and monthly thereafter. We have patients whose improvement has lasted more than 12 months.

Our results, so far, indicate that 48% of the patients operated upon have improved hearing. We have not been able to predict in the preoperative phase who will be the successful patient. Sometimes complete mobilization is obtained at surgery, but the stapes may become fixed again by fibrous union, or perhaps just fracturing the bony attachment at the footplate is not enough. There may be rough fracture lines that lock the bones again. In the revisions we have done, fracture of the crura was present in some cases and several had incudostapedial separation. In some, the stapes was firmly fixed again. It is likely that fracture of the stapes crura is not the chief cause for the failure. It is possible that complete mobilization of the otosclerotic focus did not take place originally. This is one of the factors that also bears further study. Perforations of the drum resulted in three patients. These healed with treatment. During the course of the operation, when the drum is replaced and a small perforation is noted, the edges can be apposed by advancing the skin of the canal, and by the time the pack is removed, this area will be healed. Actually this is usually no worse a catastrophe than a myringotomy incision.

Comment on Successful Results

There were 139 patients in this series (Tables 1, 2, 3, and 4). In these a total of 161 operations were performed. In some cases a revision was done; in some the other ear was done. Of these, 65 patients, or 47%, had hearing improvement. These patients had a total of 77 operations, or 48% of the total number of operations in the successful cases. Of the total number of patients, there were 69 females and 70 males. The percentage of successful results was almost the same in each group, 37 females and 28 males.

Of the 77 successful results, 14, or 18.1%, had the hearing restored to the 0-15 db. level, or approximately normal hearing; 47, or 61%, had levels of 15-25 db., and 16, or 21%, had final results within the 25-35 db. level, which could be considered on the border line of practical serviceable hearing.

TABLE 5.—*Successful Results*

Postoperative level	0-15 db.	15-25 db.	25-35 db.
Total operations (77)	14	47	16

It may be that complete freedom of motion of the stapes footplate cannot always be achieved by simple fracture of the otosclerotic bone in the region of the fissula ante fenestram that fixes the stapes footplate. Other techniques may have to be devised to accomplish this. These variations in the basic technique are already being

used. Recently Rosen [18] described a new procedure for mobilizing the footplate of the stapes.

Figures 2, 3, and 4 demonstrate the results in two patients with unilateral otosclerosis.

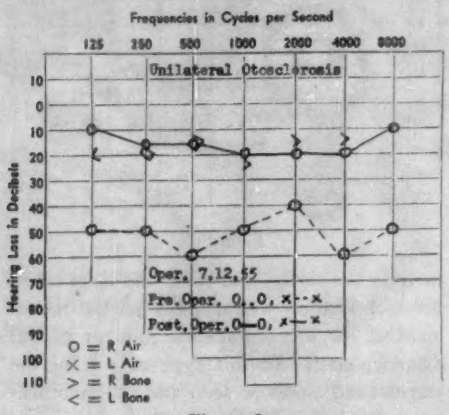
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Unilateral Otosclerosis
Hearing Loss in Decibels
10 0 10 20 30 40 50 60 70 80 90 100 110
Oper. 7,12,55
Pre.Oper. O..O, x··x
Post.Oper.O—O, x—x
O = R Air
× = L Air
> = R Bone
< = L Bone

Figure 2

Case 2.—A 40-year-old man presented an increasing hearing loss in the right ear since age 15. He was able to hear fairly well except for difficulty in directional hearing. Audiologic and otologic surveys revealed right otosclerosis. The operation was performed on July 1, 1955, and a right stapes mobilization was done. There was restoration of hearing to the practical level. Improvement sustained to present time: seven months postoperatively.

Case 3.—A female physician had unilateral deafness, noted six years following first pregnancy. Examination revealed otosclerosis on the right. The bone conduction was within normal limits,

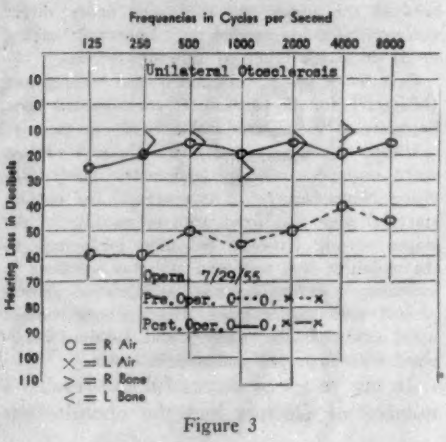
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Unilateral Otosclerosis
Hearing Loss in Decibels
10 0 10 20 30 40 50 60 70 80 90 100 110
Opera. 7/29/55
Pre.Oper. O···O, x···x
Post.Oper.O—O, x—x
O = R Air
× = L Air
> = R Bone
< = L Bone

Figure 3

and there was a wide air-bone gap. A right stapes-mobilization operation was done on July 29, 1955. The stapes was easily mobilized. The hearing improvement has been maintained to the present time.

Case 4.—A 23-year-old woman noted unilateral deafness for two years on the right. Tinnitus of a humming character was intermittent. Examination revealed a unilateral conductive deafness, with bone conduction at or near normal. The audiogram showed profound losses, with an ascending rise in higher cycles. Stapes mobilization performed Feb. 3, 1955. At time of operation the stapes was firmly fixed and vigorous prolonged traction was necessary to mobilize the fixed stapes. Hearing improvement was noted immediately after operation and has been maintained since.

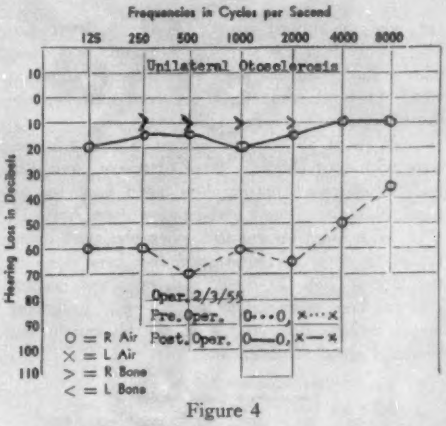
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Unilateral Otosclerosis
Hearing Loss in Decibels
10 0 10 20 30 40 50 60 70 80 90 100 110
Oper. 2/3/55
Pre.Oper. O···O, x···x
Post.Oper. O—O, x—x
O = R Air
× = L Air
> = R Bone
< = L Bone

Figure 4

Among our patients, there were nine who had successful fenestrations in one ear and in whom the stapes operation was done in the opposite ear with good results, thus a bilateral rehabilitation was obtained.

Case 5.—A female patient was first diagnosed as an otosclerotic at age 11. On Jan. 11, 1954, a left endaural fenestration was done. A fair result was obtained; air-conduction hearing remained at the practical level. There was an active fistula test present. The patient continued to have difficulty at school. On Aug. 9, 1955, a right stapes mobilization was performed under general anesthesia. The stapes was found firmly fixed and was easily mobilized. Normal hearing was obtained and has been maintained.

Case 6.—The patient, a 51-year-old woman, is a sister of Case 2, who had a successful unilateral operation (Fig. 2). Her hearing loss was present for more than 20 years. On July 3, 1951, a successful fenestration was done with an active fistula still present. The hearing improvement in the right

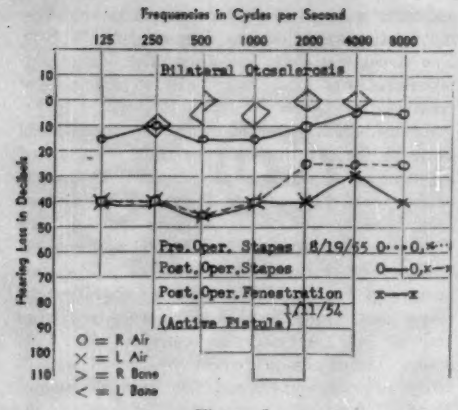

Figure 5

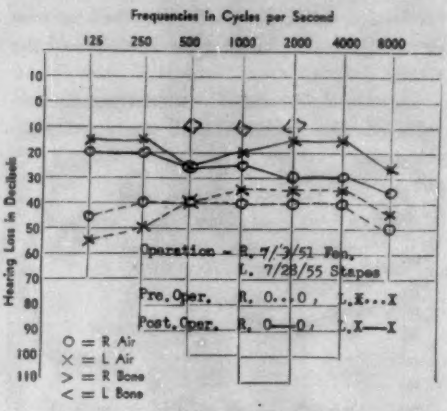

Figure 6

ear was maintained at the 20-25 db. level. On July 28, 1955, a left stapes mobilization was done, with a successful hearing result. Postoperatively a 10-15 db. level resulted. The patient now has obtained bilateral aural rehabilitation.

Case 7.—A 55-year-old woman. She is a housewife with four children, three of whom have clinical otosclerosis. Hearing loss dated back for almost 20 years. Stapes mobilization done April 15, 1955, with improvement to serviceable levels maintained to date. A fenestration had been done on the left on Feb. 10, 1952, with improved hearing that has been sustained to useful levels. Following stapes mobilization on the right, the patient had bilateral aural rehabilitation.

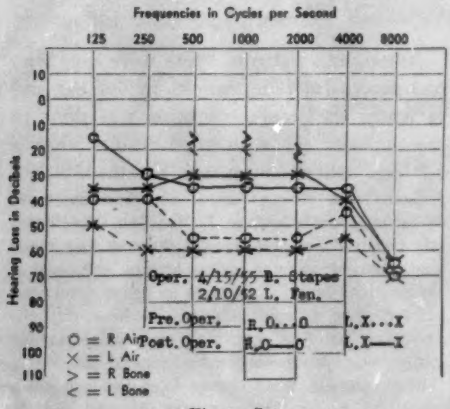

Figure 7

Some of our successful cases resulted after revision of a previous stapes mobilization with a poor result. Following revision and remobilization, better hearing resulted. In these patients operation had been done early in the series, and what had been taken for mobilization was actually partial movement of the incudostapedial joint or partial disarticulation. In this type of patient the stapes head could be seen and the mobilization was carried out under direct vision. The incus is replaced after mobilization is achieved. Good postoperative results were achieved.

Illustrations of patients with successful revisions follow:

Case 8.—Patient had bilateral hearing loss for six years. Considerable tinnitus, right. Operation done July, 1955. No result following attempted mobilization. Revision November, 1955. Examination revealed no change in audiometric study from that obtained before first operation. At the revision it was seen that what had been taken for mobilization at the first operation was a partial separation of the incudostapedial articulation. The head of the stapes was seen, and under direct vision mobilization carried out. Improved hearing to 20 db., with relief of tinnitus, resulted.

Case 9.—A 48-year-old patient had hearing loss (bilateral) for 12 years. Left ear operated upon September, 1955. Questionable result at time of operation to whispered voice test. No improvement noted postoperatively by audiometric study. Revision November, 1955. At operation the incudostapedial joint was fixed, with no motility of the stapes tendon. Pressure palpation ineffectual, so the mobilizer was employed and was sustained in increasing vigorous traction. Mobilization accomplished with audible crack. Hearing improvement noted at the time of surgery and sustained afterward with improved audiometric levels.

In our series of successful end-results, a number of patients had the opposite ear

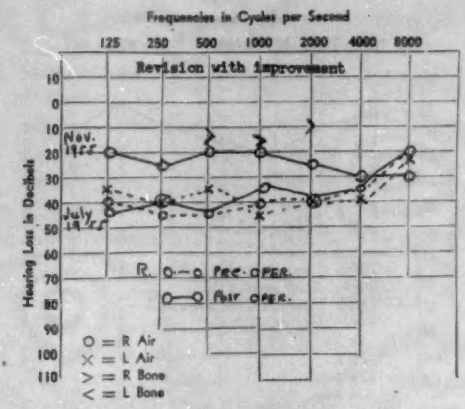

Figure 8

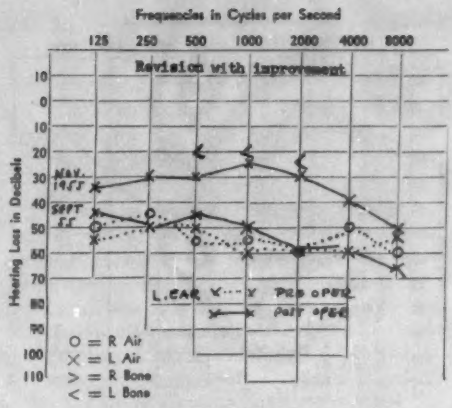

Figure 9

operated upon with equally good results, so that they had bilateral rehabilitation of their hearing.

Figures 10, 11, and 12 illustrate the results in patients with bilateral hearing rehabilitation following stapes mobilization.

Case 10.—A school teacher had increasing deafness and no response to inflation, x-ray therapy, or other forms of treatment. Audiologic study revealed bilateral otosclerosis. Left stapes mobilization done Aug. 11, 1955, with successful result to 10 db. level. Operation right ear Dec. 23, 1955; hearing returned to 20-25 db. level.

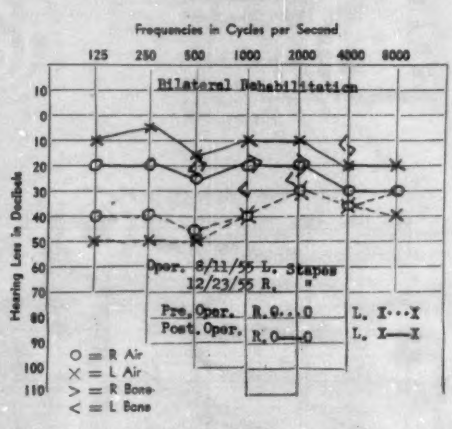
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Bilateral Rehabilitation
Hearing Loss in Decibels
Oper. 8/11/55 L. Stapes
12/23/55 R. "
Pre. Oper. R. O···O L. X···X
Post. Oper. R. O—O L. X—X
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 10

Case 11.—A 24-year-old patient had hearing loss for six years. Typical otosclerosis. Operation left ear June 6, 1955. Operation right ear July 28, 1955. Bilateral hearing level within normal range.

Case 12.—A 43-year-old patient had a left ear operation Oct. 28, 1955. Hearing gain from 60 to 40 db. level. Right ear done Jan. 6, 1956; gain 50 to 20 db., almost completely closing the air-bone gap. Successful bilateral rehabilitation.

Case 13.—The patient had a bilateral hearing loss of many years' duration. On June 30, 1955, the left ear was operated on, without results. On Nov. 4, 1955, the right ear mobilized, with excellent hearing results. The right air conduction rose to the level of the bone conduction. On Dec. 23, 1955, left ear again explored. The stapes was found firmly fixed. Again mobilization was attempted, and it seemed as though this was accomplished, but the postoperative result was poor.

Figures 14A, 14B, 14C, and 14D are the

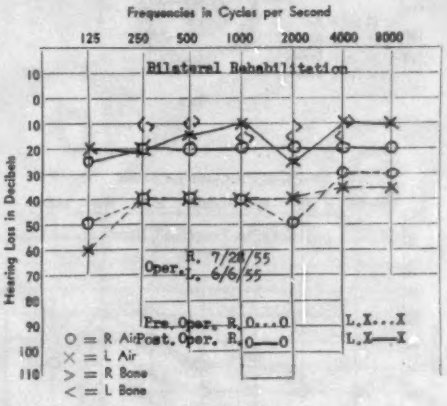
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Bilateral Rehabilitation
Hearing Loss in Decibels
R. 7/28/55
Oper. L. 6/6/55
Pre. Oper. R. O···O L. X···X
Post. Oper. R. O—O L. X—X
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 11

audiograms in a series of four patients with results after six months.

Case 14A.—Improvement to the 20-25 db. group.

Case 14B.—Improvement to the 10-15 db. group.

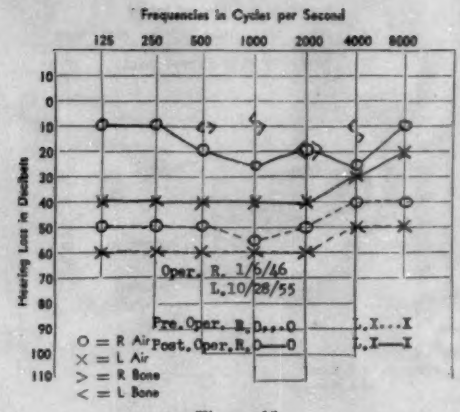

Figure 12

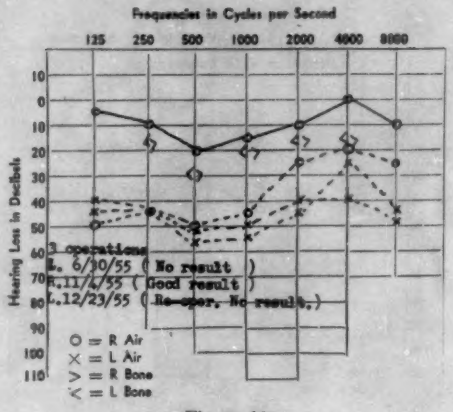
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Hearing Loss in Decibels
3 operations
L. 6/30/55 (No result)
R.11/4/55 (Good result)
L.12/23/55 (Re-oper. No result.)
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 13

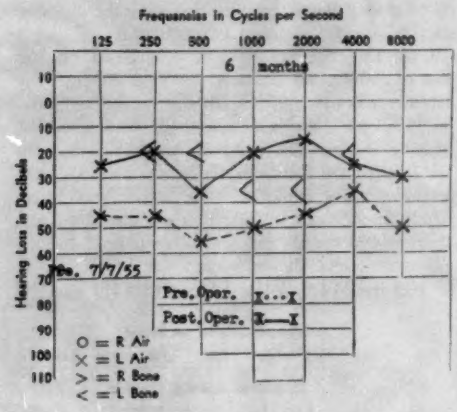

Figure 14A

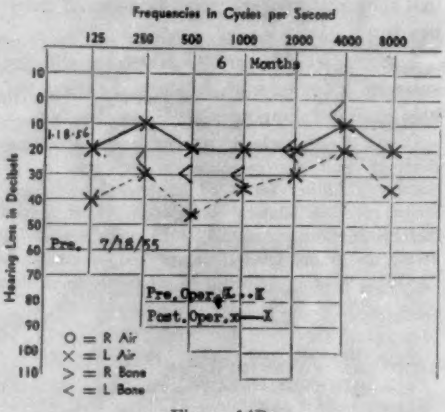

Figure 14B

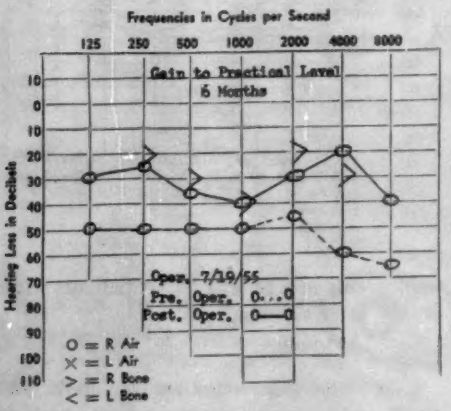

Figure 14C

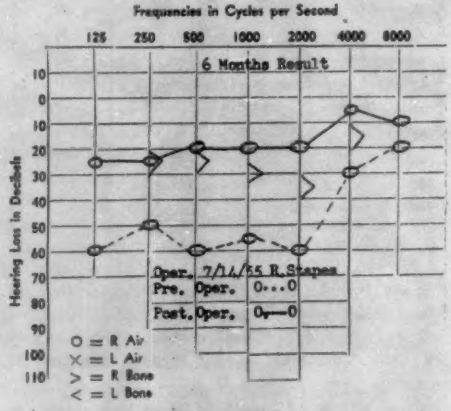

Figure 14D

CASE 14C.—In the practical group: 30-35 db.
CASE 14D.—In the markedly good group: 15-25 db. level.

Figures 15A, 15B, 15C, 15D, and 15E are the audiograms in a group of five patients. These illustrate gains in hearing at various levels. Case 15A had an immediate gain, with the audiogram made on the fifth day postoperatively after the pack was removed. The gain in Case 15B is illustrated at three months postoperatively. The gain in Case 15C was at normal levels five months postoperatively. Case 15D showed gains at one month. Case 15E made gains to a practical level four months postoperatively.

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CASE 16.—A 50-year-old patient had a hearing loss of 30 years' duration (Fig. 16). Operation Nov. 4, 1955, with successful mobilization, to level of bone conduction. The hearing was improved to within the normal range. She had been using a hearing aid for 10 years. This patient illustrates that the duration of the deafness is no barrier to the stapes procedure. If the impedance is relieved, the hearing can be improved.

So far these patients have maintained the improvements illustrated. The results range from one month to one year. Only in three patients with very successful results did

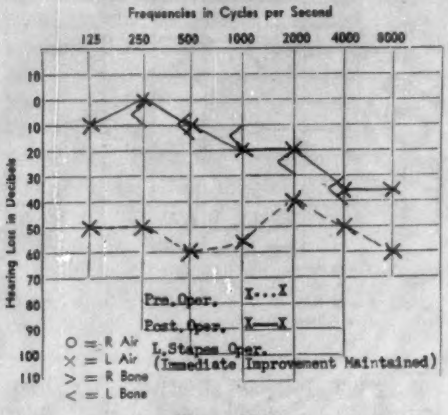

Figure 15A

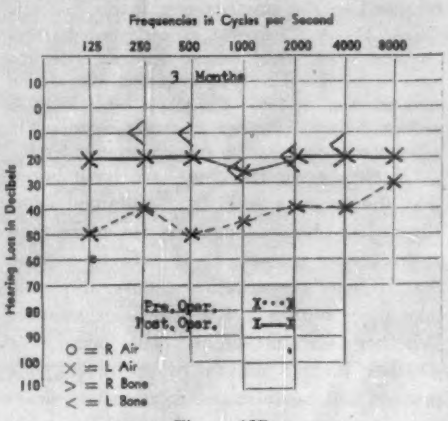

Figure 15B

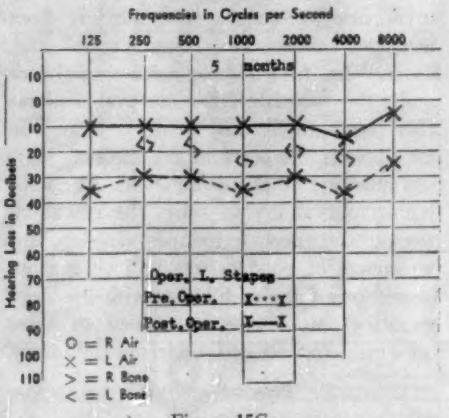

Figure 15C

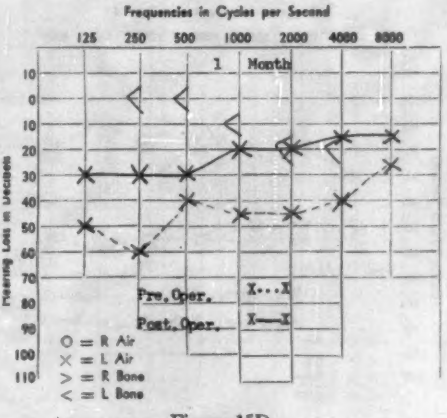

Figure 15D

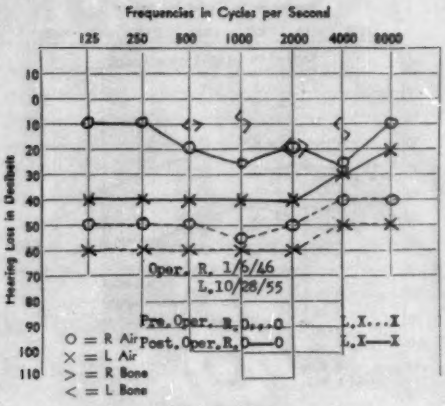

Figure 12

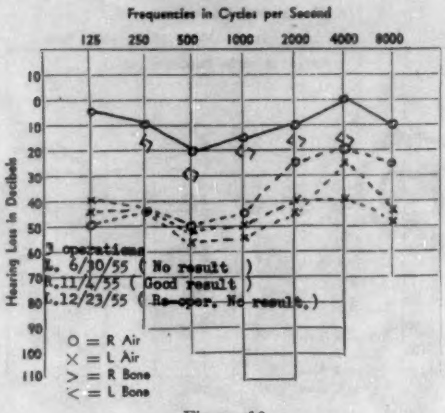
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Hearing Loss in Decibels
3 operations
L. 6/10/55 (No result)
R.11/4/55 (Good result)
L.12/23/55 (Re-oper. No result.)
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 13

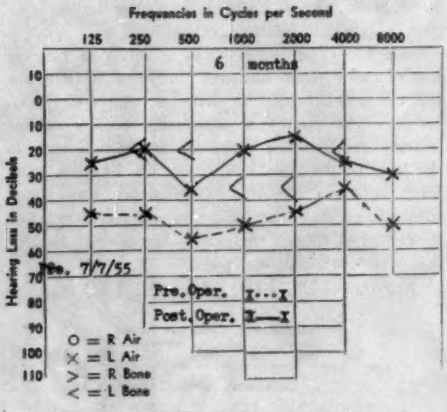

Figure 14A

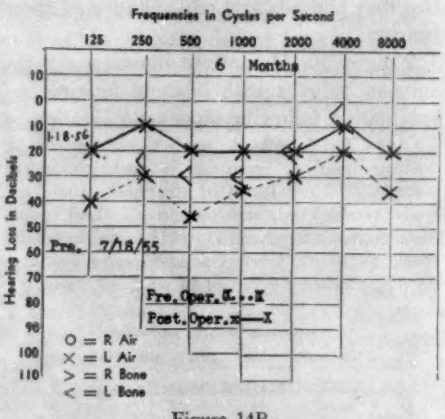

Figure 14B

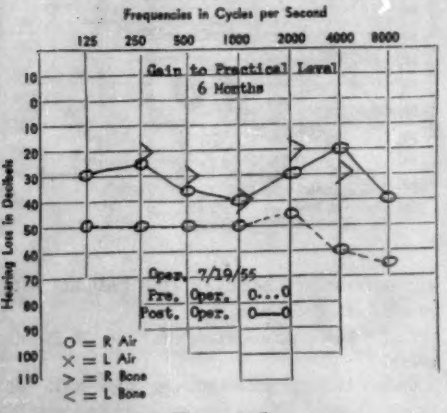

Figure 14C

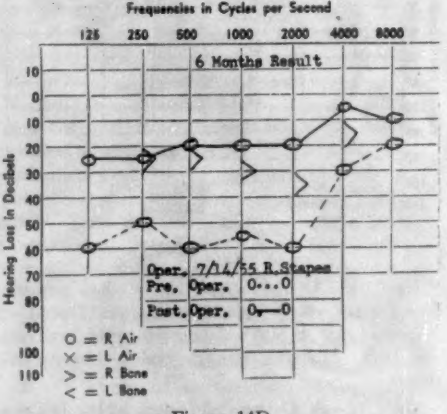
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Hearing Loss in Decibels
6 Months Result
Oper. 7/14/55 R.Stapes
Pre. Oper. O...O
Post. Oper. O—O
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 14D

CASE 14C.—In the practical group: 30-35 db.
CASE 14D.—In the markedly good group: 15-25 db. level.

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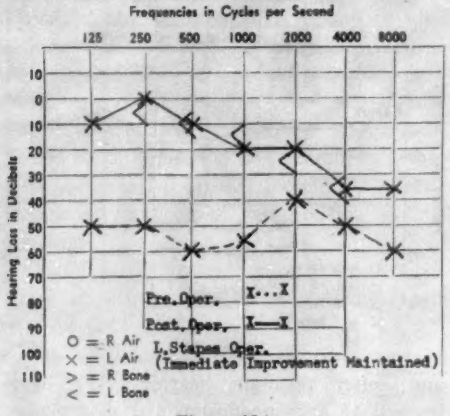

Figure 15A

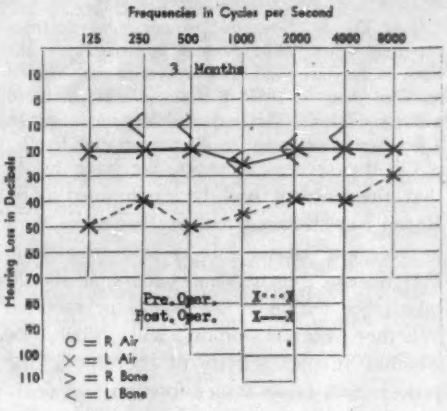

Figure 15B

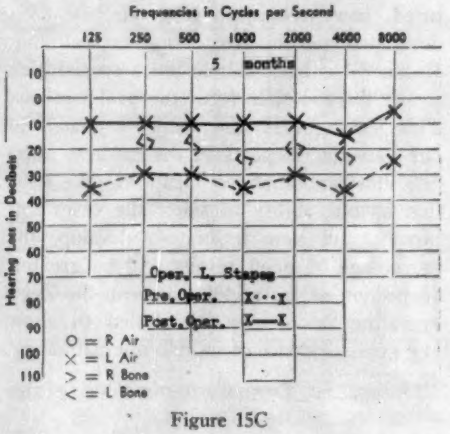

Figure 15C

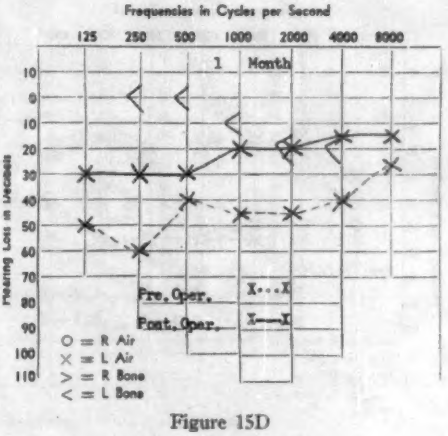

Figure 15D

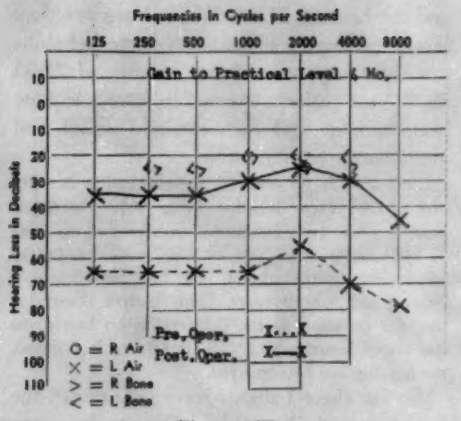
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Gain to Practical Level 6 Mo.
Hearing Loss in Decibels
Pre. Oper.
Post. Oper.
O = R Air
× = L Air
> = R Bone
< = L Bone

Figure 15E

the hearing regress. These patients had normal hearing results, and later the hearing returned to the preoperative levels.

CASE 17.—A 33-year-old patient noted deafness for four years, which became apparent after the birth of her last child. The successful mobilization done on Aug. 9, 1955. The stapes was mobilized without difficulty. Hearing markedly improved. In a few weeks regressed to the preoperative level.

Of the successful cases, we have hopes that the hearing will be maintained. Dr. Rosen has observed patients for more than a three-year period. It is safe to assume that if bone regeneration occurs, it should take place within a few weeks or months. Whether fibrous union will occur, or whether further activity of the otosclerotic process will cause stapes fixation and deafness, one must wait and see. To quote Rosen,‡ "If the hearing should regress after a matter of months or years, it would be possible to remobilize the stapes."

The successful results here presented average 48%. We are optimistic in the thought that as our experience grows, and new techniques are suggested by other otologists, a higher percentage of good results will be obtained. It takes a fair amount of patience to develop the feel of a successful mobilization. We have no doubt that in our earlier cases which were first considered as mobilized during surgery we would now continue to exert greater force in an effort to effect a more mobile stapes

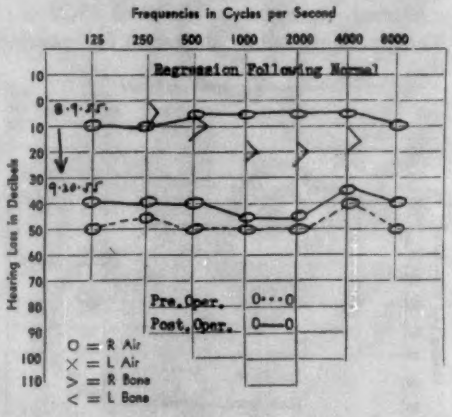

Figure 17

and better resultant hearing. We have learned to tell incudostapedial disarticulation. In cases where the crura are fractured, new techniques have already been developed which are being carried out. Rosen [13] has been able to use a special pick to lift the footplate from the oval window. This technique is now being evaluated in our patients. Reports in the medical journals illustrate other modifications. We hope that as our ability to select the cases improves, and new techniques develop, the percentage of good results will be greater. Inspection of the middle ear with the Zeiss operating microscope has failed to show any gross evidence of otosclerotic pathology.

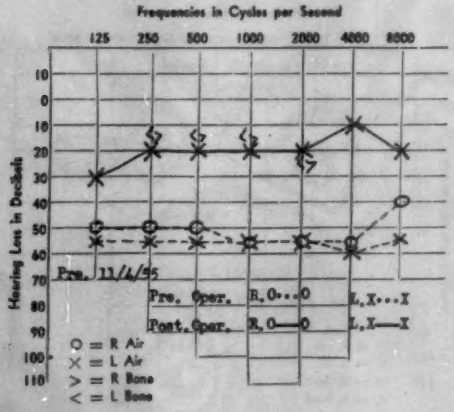

Figure 16

‡ Rosen, S.: Personal communication to the authors.

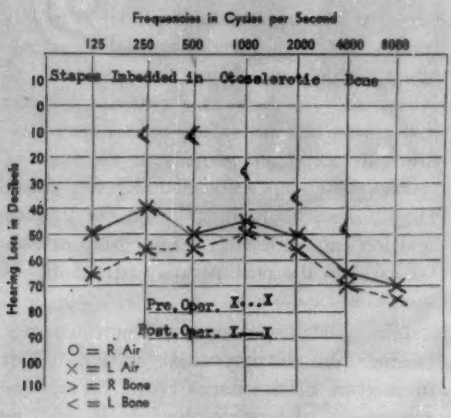
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Stapes Imbedded in Otosclerotic Bone
Hearing Loss in Decibels
10 0 10 20 30 40 50 60 70 80 90 100 110
Pre. Oper. X...X
Post. Oper. X—X
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 18

The bone changes are all within the capsule of the temporal bone. In only one patient were we able to observe a mound of otosclerotic bone which completely enveloped the stapes. This patient had a hearing loss since age 11 (Fig. 18). When the middle ear was exposed, the entire stapes was found to be embedded in a mound of bone. The incus rested on this mound. We were unable to mobilize or remove this mound of bone.

Table 6 illustrates the average decibel gains in 50 patients. The gross average was 18 db.

TABLE 6.—*Average Decibel Gain in Fifty Patients*

Gain in Decibels*	Number of Patients
4-10	12
11-17	11
18-24	9
25-31	13
33	3
38	1
45	1

*The decibel gains represent an average for seven frequencies: 125, 250, 500, 1,000, 2,000, 4,000, and 8,000. The average decibel gain of the 50 patients was 18 db.

Figure 19 is a scattergram of the total number of successful operations, which numbered 77. This reveals the improvement that occurred. It will be noted that the preoperative levels were below the 35 db. level in most cases and in the successful cases this level was moved to a practical level above the 35 db. line.

Of the total number (139) of patients operated on, 65 had tinnitus at the time the histories were taken. Many patients stated that they had tinnitus when their deafness first started, but this seemed to disappear spontaneously in most patients. Of the successful cases, 26 noted relief of tinnitus on the side operated on. In the unsuccess-

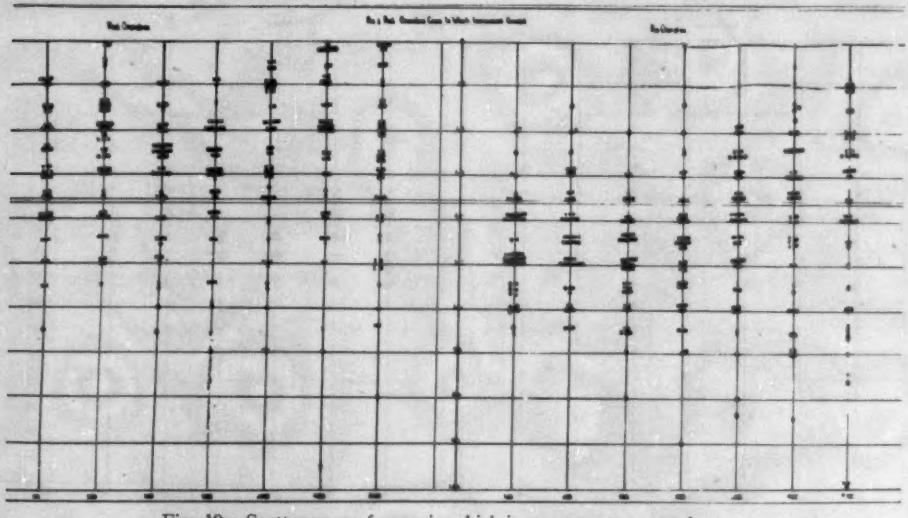

Fig. 19.—Scattergram of cases in which improvement occurred.

ful patients, the tinnitus was not relieved by the procedure.

Comment on Unsuccessful Results

The unsuccessful cases numbered 74 (53%), on whom 84 operations were done. There were five revisions without improvement after the second operation. On three patients bilateral operations were done without results. The unsuccessful cases were chosen with the same care as were the successful ones. In the main, they represented ideal patients for surgery. The tests preoperatively suggested that the patients should have had a reasonable chance of success if operated upon. It could not be predicted preoperatively that failure would result. At surgery, no difficulty was encountered. When the surgery was completed, we felt that success might result. The patients seemed to hear better and responded to the spoken voice on the operating table, yet no improvement was recorded in our postoperative studies. In these cases, the hearing receded soon, postoperatively. When the pack was removed on the fifth day no hearing improvement could be measured, and none occurred later.

Of the total number revised, eight cases, two had subsequent improvement. In these two, that which we had considered as mobilization had been incudostapedial disarticulation, which we have since learned to recognize. In these two patients a good result was obtained after proper mobilization. In six other patients at the time of revision, the stapes was found firmly fixed. Despite evident mobilization at the time of revision, no audiometric improvement was recorded in the postoperative period of observation.

It is difficult to assign specific causes for failure. We do not believe it is only due to fracture of the stapes crura, because we can usually determine this. It is amazing how much pull can be exerted before the crura fracture. Possibly, after the stapes is mobilized, the simple fracture at the footplate becomes healed, or perhaps the ragged edges of the fracture lock and fix the stapes again. Unless we have opportunity of evaluation after reoperation, we will be unable to know the reason for failure.

The scattergram (Fig. 20) and the analysis of our results show that none of the patients in our series was made significantly worse by this surgery. The postoperative audiogram usually returned to the preoperative level. There was no morbidity, no labyrinthitis, no facial paralysis, and no per-

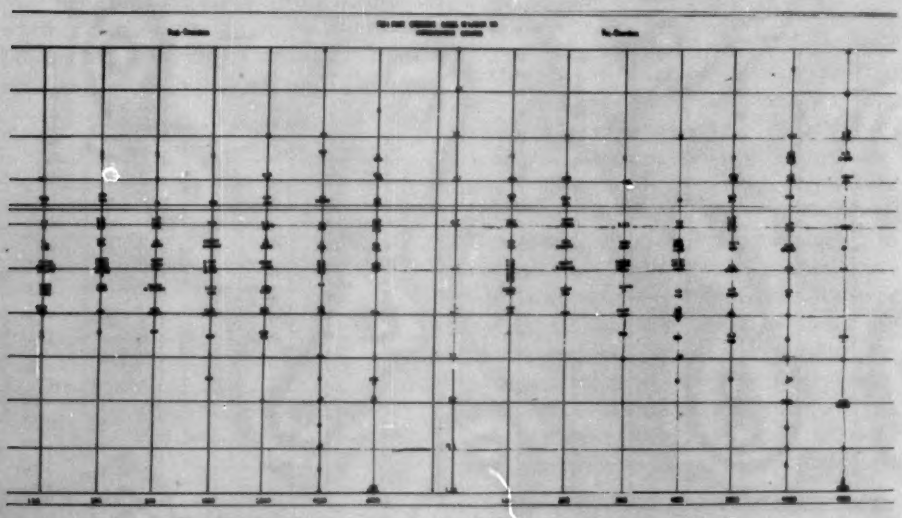

Fig. 20.—Scattergram of cases in which no improvement occurred.

sistent drainage. It is, therefore, safe to give the otosclerotic patient a chance to better his hearing with this new surgical procedure.

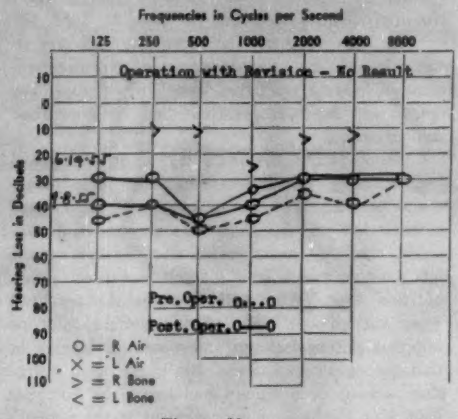
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Operation with Revision - No Result
Hearing Loss in Decibels
Pre.Oper.
Post.Oper.
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 21

In the preoperative interviews, each of our patients is carefully prepared as to the possibilities of the operation, its techniques, and anticipated results. In the main, most of them accept the failure without too much psychological trauma because they actually suffered little by submitting to the procedure. Most prepare themselves for operation on the opposite ear. Two patients with failure have had successful fenestrations. No surgical difficulties were encountered because of the previous stapes operation.

Case 21.—A patient in whom a revision was done. This patient had noted increasing deafness during the past five years. Audiologic survey revealed a typical bilateral otosclerosis. The bone conduction audiometrically was well within the normal limits, there was good response to amplified sound, and the bone conduction was prolonged by tuning-fork test. On June 14, 1955, a right stapes mobilization was done. No improvement occurred. On Sept. 8, 1955, the same ear was revised. The stapes operation was performed without difficulty. Again the stapes was found firmly fixed; mobilization seemed to occur. Postoperative study revealed no significant change in her audiometric findings.

Case 22 (Figs. 22A and 22B).—The 57-year-old patient was a known otosclerotic for more than 30 years. The patient wore a hearing aid for the past 10 years. Auditory study revealed bilateral otosclerosis with a definite air-bone gap. It was hoped that we could achieve mobilization, thus narrow the air-bone gap, and then perhaps the patient could do without a hearing aid. A left stapes was done on Feb. 21, 1955, and a slight rise in the lower tones was obtained. The right ear was done on Aug. 1, 1955, with no result. The patient has returned to wearing a hearing aid.

Case 23.—The patient had severe otosclerosis bilaterally with some evidence of cochlear degeneration. On May 17, 1955, a left stapes mobilization was performed. The stapes was firmly fixed. There was apparent mobilization at the time of operation. No improvement in hearing was detected audiometrically in the postoperative period. There was no deterioration of the hearing as the result of this experience.

In an attempt to survey all the possibilities of the stapes operation, we should also mention those patients operated upon who

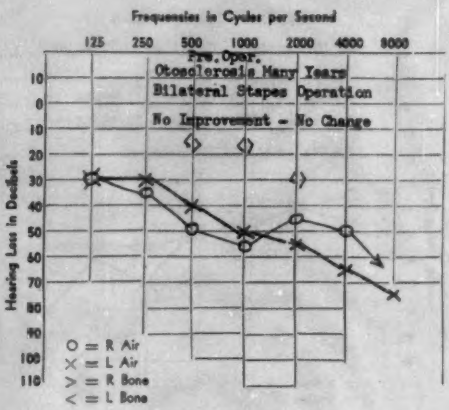
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Pre.Oper.
Otosclerosis Many Years
Bilateral Stapes Operation
No Improvement - No Change
Hearing Loss in Decibels
O = R Air
X = L Air
> = R Bone
< = L Bone

Fig. 22A (Case 22)

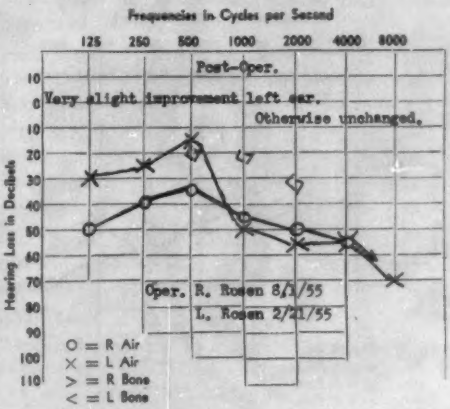

Fig. 22B (Case 22)

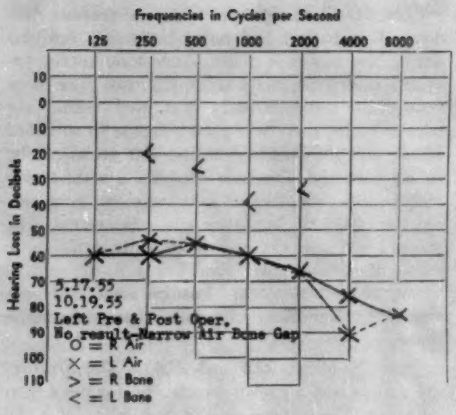
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Hearing Loss in Decibels
5.17.55
10.19.55
Left Pre & Post Oper.
No result-Narrow Air Bone Gap
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 23

were not ideal cases. These operations were done with the patients' full consent and knowledge of the possibilities of the operation.

CASE 24 (Figs. 24A and 24B).—A 61-year-old physician was a known otosclerotic of many years' duration. There was a marked loss in the bone conduction. A bilateral stapes operation was done. The right side was operated on Oct. 28, 1955, and the left on Dec. 30, 1955. At the operation the stapes was firmly fixed. Strong pull was needed to mobilize the stapes. After the mobilization, the patient had a marked nystagmus for about one hour. This was relieved by the use of cyclizine lactate intramuscularly. There was no recurrence of the nystagmus. The postoperative audiometric studies revealed no change in the patient's hearing. No further progression of the hearing loss occurred. Since there was no air-bone gap, it is likely that no improvement should have been expected.

CASE 25.—A 35-year-old patient had deafness of 16 years' duration. The audiometric study revealed a bilateral typical otosclerosis. A left stapes-mobilization operation was done on July 5, 1955. No improvement occurred. On Dec. 23, 1955, the left ear was revised. There was no difficulty in carrying out the second operation. No improvement in hearing occurred. Very little change was noted in the preoperative and postoperative audiograms.

CASE 26 (Figs. 26A and 26B).—The patient had long-standing bilateral otosclerosis. The bone-conduction levels were near normal. Attempted mobilization on the right was unsuccessful. Revision was also unsuccessful. Mobilization on the left gave no result. It is difficult to explain a case of this type. Apparently successful operations were carried out with good technique, and no improvement of hearing was obtained. It may be that the otosclerotic focus was much more diffuse than average and simply mobilizing the footplate could not produce an improvement in the patient's hearing.

Summary

The stapes-mobilization operation has opened a new vista in the surgical rehabilitation of the deafened patient with otosclerosis. It is an acceptable surgical procedure that can restore hearing to practical or normal levels. The operation is physiologically correct, restoring the impedance-matching mechanism to normal, when successful. In this series of patients there have been no untoward complications. A statis-

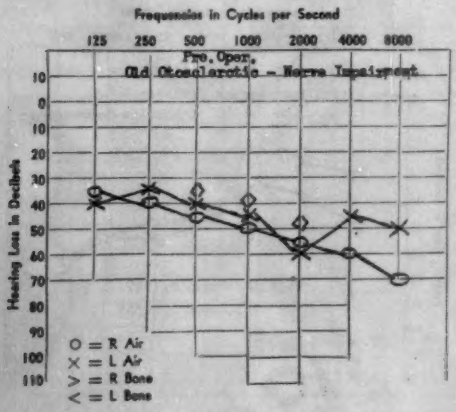
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Hearing Loss in Decibels
Pre. Oper.
Old Otosclerotic - Nerve Impairment
O = R Air
X = L Air
> = R Bone
< = L Bone

Fig. 24A (Case 24)

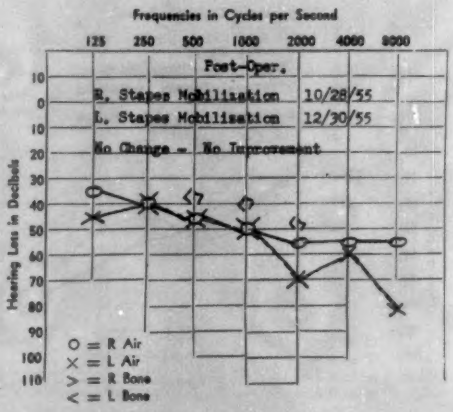
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Hearing Loss in Decibels
Post-Oper.
R. Stapes Mobilization 10/28/55
L. Stapes Mobilization 12/30/55
No Change - No Improvement
O = R Air
X = L Air
> = R Bone
< = L Bone

Fig. 24B (Case 24)

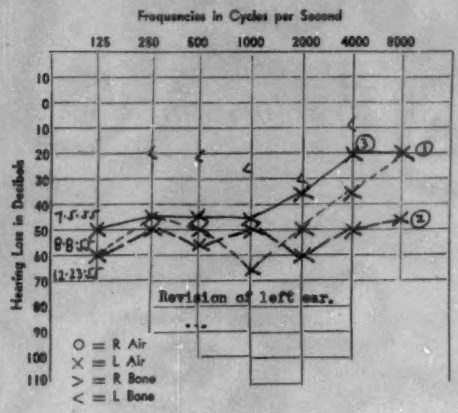
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Hearing Loss in Decibels
Revision of left ear.
O = R Air
X = L Air
> = R Bone
< = L Bone

Figure 25

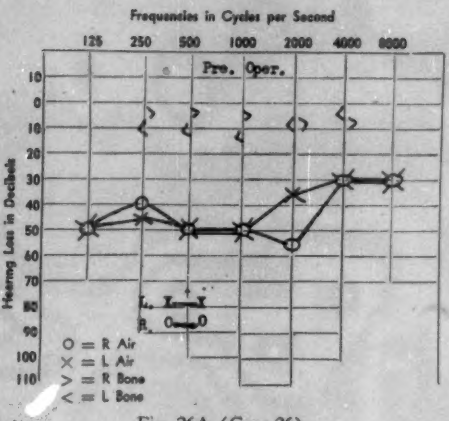
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Pre. Oper.
Hearing Loss in Decibels
O = R Air
X = L Air
> = R Bone
< = L Bone

Fig. 26A (Case 26)

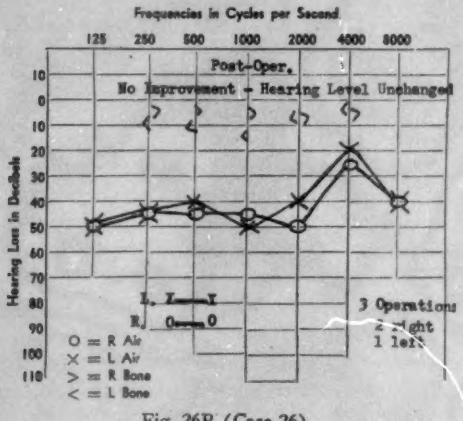
Frequencies in Cycles per Second
125 250 500 1000 2000 4000 8000
Post-Oper.
No Improvement - Hearing Level Unchanged
Hearing Loss in Decibels
3 Operations
O = R Air
X = L Air
> = R Bone
< = L Bone

Fig. 26B (Case 26)

tical review is offered with the end-results in a series of 139 patients operated upon in various stages of clinical otosclerosis.

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Treatment of Subcondylar Fractures by the Endaural Approach

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The goal in the treatment of all fractures is the readjustment of the fractured parts to their normal alignment, and a maintenance of the parts for a sufficient length of time so that healing may occur. This is not always possible due to the inaccessibility of certain osseous structures. In the spine, for example, accessory external methods are used most frequently to obtain healing in a close to normal position. The surgical difficulty in these cases makes it necessary to rely on other than direct techniques. On the other hand, there are fractures, such as in the radius, tibia, etc., where external fixation is, in the greatest number of cases, perfectly adequate. On the one hand, we have almost insurmountable technical difficulties and, on the other, a situation where direct fixation is unnecessary and where external fixation is adequate for good linear healing.

Treatment of subcondylar fractures has been relegated to a limbo of negativistic therapy due, in part, to a feeling that the area is inaccessible without great danger to important structures. Consequently, external splinting is used with no attempt at definitive fixation for anatomical healing. This, we feel, is completely unsurgical and leaves much to be desired.

The condylar neck is the narrowest part of the mandible and consequently particularly subject to trauma. The attachment of the external pterygoid muscle to the anterior meniscus and condyle invariably causes this fragment to be rotated anteriorly and medially. There may be a fracture dislocation of the upper fragment with displacement to a very deep anterior position. Together with this, the lower poriton is pulled superiorly due to the action of the internal pterygoid, masseter, and temporalis muscles. This results in a loss of vertical dimension. The majority of these cases have major displacement due to the pull of the above muscles, which will not allow spontaneous alignment. Fracture in this region occurs on an all-or-none basis. Partial fractures or impacted fractures are rare, or if they do occur, they are not frequently picked up roentgenologically.

Bellinger[1] reports 100 cases of condylar fracture. The condyle remained in the glenoid fossa in 16 with "some" overlapping. Fifty-seven cases had displacement but there was "some" approximation. (The quotation marks are ours.) Two cases were associated with comminution of the joint surfaces. Twenty-five had complete disarticulation. Our impression was that not many of these had what we consider good anatomical alignment of the fractured parts.

MacLennan,[2] in his series, reports 106 single or bilateral condylar fractures without mandibular body or ramus fracture and 63 single or bilateral condylar fractures complicated by mandibular body or ramus fracture. There were almost twice as many uncomplicated as complicated condylar fractures. Single condylar fractures were much more frequently associated with other mandibular fractures than bilateral condylar fractures. There were twice as many single as bilateral condylar fractures.

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Chipps, Canham, and Makel,[3] in a series of 662 mandibular fractures in the Korean War, state that only 10% of the mandibular fractures were complicated by single or double condylar fracture. This percentage is higher in civilian trauma, where, in the main, the causative factors are automobile accident and injury caused by fist blow.

Lateral and posteroanterior x-rays are usually sufficient to demonstrate this type of fracture. Tomograms are sometimes necessary to give good visualization of the fracture position (Fig. 3A, preoperative tomogram). We suspect that on occasion, due to faulty technique, these fractures are missed, especially in the lateral view due to superimposition of other osseous shadows.

Treatment

Conservative

The preponderance of opinion tends to the conservative approach, namely, interdental wire fixation for a period of from three to six weeks. McDowell, Brown, and Fryer describe the treatment of these fractures as follows, ". . . in fractures through the neck of the condyle, displacement is not so apt to be as bad as is commonly believed and interdental wiring in occlusion will usually suffice." They continue, "If the condyle does tip clean out of line, necrosis or ankylosis may occasionally result and secondary resection becomes necessary."

MacLennan[2] concludes that the results of external fixation are as good as interosseous wiring or pin fixation. Not one of his total large series of 180 cases had open reduction. He admits that alignment is not obtained in this manner but that some type of bony or fibrous union is generally established. He lists only nine cases with real complications: two with continued pain and seven with visual deformity. Eighteen of his total group received no treatment at all. His results are truly remarkable.

Shapiro, O'Brien, and Wilkie[5] feel that three weeks of interdental wiring is sufficient if only one condylar neck is fractured to obtain a good functional result; but in bilateral condylar fractures, because of the open-mouthed deformity, open interosseous fixation is done on one side.

Goodsell[6] feels, too, that satisfactory function without accurate alignment is obtained by external methods of fixation.

Ivy and Curtis[7] suggest a method of interposing gutta percha baseplate between the molar teeth, together with dental fixation, to increase the vertical dimension of the shortened fractured side.

Gerry[8] indicates that open reduction should be reserved as a final method of treatment and only in cases of severe fracture dislocation. He suggests that condylectomy in this type of case may even be more valuable than interosseous wiring.

Open Reduction

Thoma[9] states that those who say they have never seen functional disturbances resulting from the healing of fractures in abnormal position may not have followed up their cases over a long period of time. He continues that complications of "malocclusion, limitation of motion, blocking of motion, pseudo-arthritis, functional pain, arthritis and fibrous and bony ankylosis" may occur months or years after the original treatment. In 1954, he reported a case of condylar fracture which by lateral x-ray showed a slight displacement and which was treated by intermaxillary fixation for five weeks. After this therapy the patients had cross bite, swelling of the face, and numbness of the same side of the lips, nose, and cheek. An x-ray, taken when he saw this patient 11 weeks after injury, revealed the fragment to be severely displaced medially. He treated the patient by condylectomy, and the symptoms disappeared. He felt that the anesthesia of the part was caused by pressure on the mandibular division of the fifth nerve. It seemed probable that the immediate x-ray after this accident revealed good position, but because of the continuous pull of the external pterygoid muscle on the superior fragment, it became medially displaced. Where there are no opposing molar

teeth this may be seen earlier due to the immediate shortening of the body by the unopposed action of the masseter and external pterygoid muscles.

It is obvious when one searches the literature that the weight of feeling tends toward the conservative approach to this problem. Because a patient usually obtains some type of hinge-joint action with which he can get along and although malocclusion usually occurs, together with pain and some deformity, the real definitive therapy is overlooked, namely, open reduction.

One asks immediately, "Why?" We feel that the answer lies in the difficulty of the procedure and the danger to the branches of the facial nerve. The incisions of Blair,[10] Wakeley,[11] Dingman,[12] Henny,[13] and Richardson,[14] to mention a few, all have as their purpose preservation of the seventh nerve or its branches. Not one of their incisions can with certainty exclude the branches of the seventh nerve from the field. If it were possible to directly treat these fractures openly by a simple approach and without danger to the seventh nerve and without visible scarring, we are positive that almost all condylar fractures would be so treated. All the complicated systems of fixation followed by countless systems of interdental exercise and physical therapy would be abandoned.

In November, 1954, an endaural approach to the temporomandibular joint was described by one of us[15] for the purpose of meniscectomy. This approach results in no obvious scarring and has the advantage of bypassing the parotid gland, all branches of the facial nerve, and the temporal artery. Continued experience with this approach soon demonstrated that more of this area could be made accessible up to the point where drilling and wiring of the fractured ends became completely feasible.

Technique

General anesthesia by nasal intubation is used. The head is prepared and draped as in endaural surgery with a further exposure of the angle of the mandible. The area of the incision is injected with about 5 cc. of 1% procaine hydrochloride with 1:1000 epinephrine, in the proportion of 10 minims (0.6 gm.) to the ounce of procaine, primarily for the purpose of hemostasis. The first incision is an exact duplicate of Lempert's[16] second endaural incision. It begins well within the external auditory canal down to bone and extends upward in a curvilinear manner, hugging the anterior helix and becoming less penetrating as it approaches the surface and ends at about the level of the inferior crus. The incision is deepened until the temporalis muscle fascia is identified. Bleeding points are clamped and coagulated. The second incision is a continuation of the first incision, starting at its endaural limit and sweeping anteriorly and downward in a circular manner within the canal on the posterior surface of the tympanic plate. The blade at this time must be in continuous contact with the tympanic plate. If the incision is external to the edge of the tympanic plate the parotid gland will be incised. The incision describes almost a complete half-circle. Before it becomes a complete half-circle, it is extended in a straight line anteroinferiorly in the incisura intertragica, cutting through the cartilage in this area and ending as it approaches the surface (Fig. 1A). With a periosteal elevator the temporalis muscle is undermined and the root of the zygomatic arch is identified. After this the capsule is exposed with sharp dissection.

Horizontal incisions are then made into the joint, and the meniscus is removed by sharp dissection (Fig. 1B). The rake retractor is now discarded and narrow, right-angle retractors are used. Bleeding is controlled by clamping and coagulation. The angle of the mandible is now engaged through the skin with a towel clip. In this manner the lower fragment is manipulated and steadied. Sharp dissection is then used on the periosteum of the lower fragment until bone is contacted, and the periosteum is then separated from this fragment with

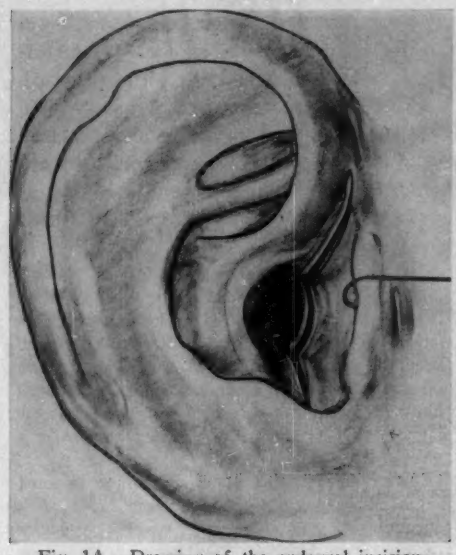

Fig. 1A.—Drawing of the endaural incision.

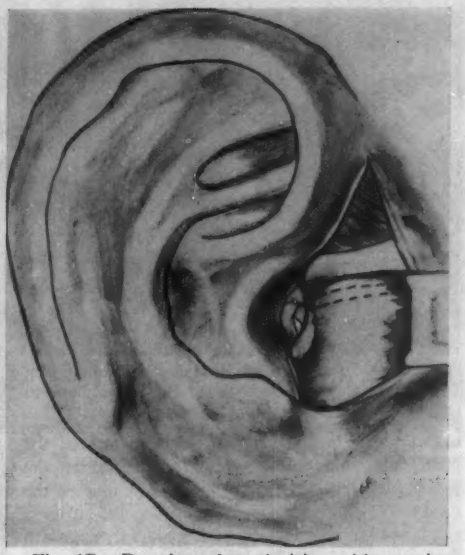

Fig. 1B.—Drawing of the incision with anterior retraction showing the temporalis muscle, root of the zygoma, and parallel incisions in the joint capsule.

a periosteal elevator. This dissection and exposure is completely subparotid, so that none of the anterior auricular vessels or branches of the seventh nerve are endangered. Dissection is not continued superficially in the lower recess of the wound. This portion is exposed by simple elevation with a right-angle retractor. The upper fragment is then sought and is usually found lying anteriorly and deeply in close association with the external pterygoid muscle. It is partially freed from its capsular attachments. It is important to leave some of the external pterygoid muscle attachments to the upper fragment for blood supply. This fragment is then steadied with a towel clip and is held in its normal anatomical position, namely, with its broad diameter in the transverse position. Single holes are then bored with a Kirschner wire in the upper and the lower fragment, and double 26-gauge wire is passed and twisted on the outer surface. No attempt is made to suture the capsule. When retractors are removed, the elevated structures cover the wired parts in a natural manner. The upper portion of the wound is closed with interrupted 0000 nonabsorbable surgical (silk) sutures, and wick is inserted in the external canal. The wound is not drained. The mandible is then immobilized with an Elastoplast sling for a period of three weeks, after which the patient is placed on a liquid diet for another three weeks and advised not to open the mouth unduly during this period.

Report of Cases

Case 1.—A Negro man, aged 32, was admitted to St. Vincent's Hospital on Sept. 10, 1955. A short time before admission he was struck on the jaw by a fist and became unconscious. The duration of unconsciousness could not be determined. Neurologic examination at the time of admission was negative. Spinal-fluid examination showed completely normal values.

Physical examination revealed swelling of the left condylar region and deviation of the mandible to the left. There was no physical evidence of mandibular fracture other than the suspected left condylar fracture. X-ray (Fig. 2A) revealed a subcondylar fracture on the left side and, together with this, a fracture in the right mental region. This latter fracture was in excellent alignment. However, the subcondylar fracture was associated with a marked displacement of the upper fragment and a shortening of the body of the mandible. An

Fig. 2A (Case 1).—Preoperative tomogram (edges of fragments outlined). Vertical dimension of the ramus decreased.

ordinary Elastoplast sling dressing maintained the good alignment of the mental fracture during the period of decision concerning the handling of the condylar fracture. It was finally decided to do a combined submandibular and endaural approach for pinning of the condylar fracture. Previously, in another patient, a condylar fracture was pinned by the submandibular approach. At that time great difficulty was experienced in immobilizing the upper fragment for insertion of a Kirschner wire. We felt at this time that, aided by the endaural approach, direct visualization of the passage of the Kirschner wire into the upper fragment together with the greater ease in immobilizing the upper fragment would make the procedure much simpler.

Fig. 2B (Case 1).—Postoperative tomogram with Kirschner wire in place (edges of fragments outlined). Note increase in vertical dimension of the ramus.

This proved correct, and the operation was completely successful (Fig. 2B, postoperative x-ray). Elastoplast was again used as an external dressing, and the patient was discharged on Oct. 19, 1955, with a completely satisfactory result. His dental occlusion was good, and he masticated with a minimum of pain.

The endaural approach helped greatly in positioning the upper fragment and directing the Kirschner wire. We were surprised, however, at the amount of working room available with this approach, and we decided that with our next case we would discard the submandibular incision and use only the endaural approach with interosseous flexible wiring.

Case 2.—A white female patient, a known epileptic, was admitted to St. Vincent's Hospital on Nov. 19, 1955, with a history of having suffered a convulsive seizure at home. Examination revealed the presence of a fracture of the right forearm and marked retrusion of her mandible, with severe pain and swelling of both condylar regions. A diagnosis of bilateral subcondylar fracture was made.

Routine lateral and posteroanterior x-rays of the mandible did not give adequate information concerning the exact position of the condylar fracture fragments; so laminography was done bilaterally. The report was as follows, "Examination of the mandible by laminography reveals interruption of the osseous continuity involving the base of both articular processes. The mandible is displaced in a cranio-proximal direction. The lower fragments are in approximation to the articular surface of the temporomandibular joint."

Because of the absence of molar teeth, the mouth gaped open and the mandible was in a position of marked retrusion. Mastication was impossible, but because of a peculiar emotional status the patient resisted definitive therapy until Dec. 9, 1955, when, finally, with the patient's consent, endaural wiring of the left subcondylar fracture was performed. We felt at this time that fixation of one side would correct the poor bite sufficiently so that function of the mandible could be partially improved. Although the vertical dimension on this side was improved and there was no overriding of the fragments, postoperatively there was angulation at the fracture site. The pain in this repaired side disappeared, but the pain on the opposite side continued, and the patient at this time insisted on further surgery. Consequently, on Jan. 16, 1956, open reduction was performed on the right side. This was 58 days from the time of injury. The upper fragment on this side was markedly displaced deeply and anteriorly (Fig. 3A) and imbedded in fibrous tissue, but, notwithstanding these anatomical disadvantages, the endaural approach was more than adequate for exposure and successful interosseous wiring was performed (Fig. 3B).

The patient at this time has good occlusion of her incisor teeth with no retrusion. The vertical dimension of her mandible appears normal, and she is able to masticate as she did before the accident.

Fig. 3A (Case 2).—Preoperative tomogram (fragments outlined). Decrease in vertical dimension with retrusal open-mouth deformity.

Fig. 3B (Case 2).—Postoperative tomogram of interosseous wiring of subcondylar fracture. Wire barely visible in this plane (reduced fracture outlined). Note increase in vertical dimension, with consequent correction of retrusion and open-mouth deformity.

We learned from this case that interosseous wiring of just one side in bilateral fractures does not give a satisfactory result. The pull from the opposite side, especially in the absence of molar teeth, creates a poor bite. Furthermore, pain disappears only when there is proper alignment. In the future we shall reduce and wire both fractures at the same time.

Summary

All fractures heal best when the displaced elements are fixed in anatomical alignment. Some fractures (vertebrae), owing to their inaccessibility, are treated by external methods. There are other fractures (long bones) where good approximation may be obtained by external splinting.

The treatment of subcondylar fractures has been, in the main, by external splinting (interdental wiring). This in the great majority of cases does not give approximation of the fractured surfaces. Accurate approximation can be obtained only by direct interosseous wiring and must, of necessity, give better mandibular function.

The deterrents to the open reduction of subcondylar fractures are (1) danger to the branches of the facial nerve, (2) difficulty of the procedure, and (3) scarring.

Described is a comparatively simple and a safe approach, without scarring, through which interosseous wiring of subcondylar fractures is feasible.

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Intranasal Chondrosarcoma

A Supplemental Case Report

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Chondromas, from which chondrosarcomas originate, have a typical pattern with the following characteristics: 1. Their cells are arranged singly, not in groups; 2. They are not vascular; 3. They are liable to undergo myxomatous degeneration; 4. They grow slowly and exhibit histologic evidence of a high degree of differentiation; 5. They are capable of local invasion; 6. They tend to recur.

Chondrosarcomas exhibit these specific evidences of malignancy: 1. The intercellular matrix is poorly formed; 2. There is increased cellularity; 3. There are irregular nuclear patterns; 4. There is obvious accelerated growth at the margin of the lobules. The primary type, according to Coley,[1] arises from relatively undifferentiated cells in the perichondrium. These cells give origin to tumors which usually occur in young persons, and a striking feature is the development of metastases and extensions into the veins. The secondary type, which is commoner, often arises from cartilage rests remaining in the central portion of the bone after ossification has occurred and is nearly always seen in adults. Ewing[2] states that tumors which are softer and more cellular are more malignant and stresses the point that in establishing the diagnosis of chondrosarcoma both histologic and clinic features should be carefully considered.

Chondrosarcoma rarely involves the intranasal structures and paranasal sinuses. A conservative operation for removal will be followed by recurrence, the rate of growth being considerably determined by the age of the patient. An extensive operation, sacrificing a safe amount of adjacent normal tissue, is necessary if the tumor is to be successfully eliminated. The case report will adequately illustrate that when the tumor is located intranasally early treatment should involve radical elimination of structures giving origin to a chondromatous neoplasm. In reviewing the record it seems that it is an error to leave apparently normal tissue at the base, which may still harbor chondroma tumor cells. In an advanced stage with secondary invasion the spread, especially into paranasal sinuses, may be beyond the limits of practical operability in the sense of establishing a cure. Experience has demonstrated that surgery and even radiation or a combination of the two can accomplish temporary regression of the tumor growth, prolong life, and reduce discomfort. The tumor progresses slowly, especially in older persons, and may or may not metastasize late to the lungs. A preliminary report of the patient to be described has previously been published.[3] The malignant tumor in this instance originated in the bony portion of the nasal septum, and the paranasal sinuses were involved only secondarily.

Other malignant lesions may originate in the paranasal sinuses. They are rarely confined to a single set of air cells at the time of diagnosis. Accurate classification of the exact anatomic site of origin is under some circumstances impossible. When lesions arise in the floor or lateral wall of the antrum a bulging mass may be present in the mouth or cheek. When the mesial wall of the antrum gives origin to the neoplasm there is erosion of the party wall and exten-

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sion commonly into the nasal cavity, ethmoid cells, sphenoid sinus, and orbit. Similar involvement is seen when the neoplasm originates in the ethmoid. The extent of involvement is largely conjecture without surgical exploration. Primary tumors in the maxillary antrum are six or seven times more frequent than those arising in the ethmoid cells.[4] Primary neoplasm is rarely demonstrated to have arisen in the frontal or sphenoid sinuses, although these cells are frequently involved secondarily. The fact that these sinuses have a lessened incidence of inflammatory conditions may have etiological significance in their lessened incidence of primary neoplasms.

Soboroff and Lederer[5] have reported a similar unusual case of chondrosarcoma originating intranasally. Their patient, aged 40, died nine years after the first complaint of nasal obstruction and seven years after the biopsy. In this instance there was also progressive loss of vision, first in the right eye and then in the left eye, progressing to total blindness. There were no metastases. Certain other features are reviewed because of their interest in the present case presentation. The tumor mass involved the nasal septum and paranasal sinuses bilaterally. It grew up and back, eroding the base of the skull. The sella turcica was completely destroyed as well as the anterior tips of the petrous portions of both temporal bones. The optic chiasm was stretched up and back over this expanding mass of tumor, and the right optic nerve disappeared into the mass of tumor. The tumor extended anteroposteriorly from the cribriform plate to the anterior margin of the foramen magnum.

Report of Case

History.—A married woman, aged 81 (twice the age of the patient in the record just reviewed), had a chondroma removed from the left nostril May 7, 1942, at the Mayo Clinic by Dr. Gordon New. This tumor originated from the nasal septum and did not invade other structures in the left nostril. Dr. New's report, dated Oct. 26, 1949, stated: "Mrs. . . . came here May 4, 1942 with a history of having had 44 x-ray treatments in 57 days for a nasal tumor. I operated May 7, 1942 removing a chondroma which completely filled the left nostril, bulging the medial wall of the left antrum and displacing the nasal septum to the right. The tumor was attached at the septum and presented at the left anterior vestibule of the nose. It was about 4 cm. by 5 cm. in size. Microscopically it was diagnosed—chondroma." Seven years later, Sept. 20, 1949, the patient reported to the Otolaryngology Clinic of the Evanston Hospital complaining of right nasal obstruction (the opposite side) and purulent drainage from the right nostril. The left side was clear and roomy (the site of the tumor removed by Dr. New). The purulent drainage was cleared by irrigations of the right antrum and the use of antibiotics. May 31, 1950, the patient was operated on, under diabetic management, in an effort to clarify the diagnosis and eliminate tumor tissue from the right nostril and right antrum. The nasal septum was the apparent origin of friable tumor tissue invading the right nasal vestibule and the right antrum. Curettement and biting forceps eliminated tumor tissue as thoroughly as anatomic limits would permit. To have attempted, at this stage, to eliminate every vestige of tumor would have produced a wholly unacceptable cosmetic and functional result with little probability of preventing recurrence. The pathologic diagnosis was "chondrosarcoma of the nasal septum and right maxillary sinus." After surgery Dr. Anna Hamann, radiation therapist, Evanston Hospital, gave deep roentgen therapy repeatedly as clinical indications warranted. The first treatment series (consisting of 12 treatments) was from June 20, 1950, to July 6, 1950, a period of 16 days. The rays were directed over the right antrum anteriorly and laterally with the use of two ports (4 by 6 cm.); the skin dose was 3550 r and the lesion dose 2485 r. Over the next four and one-half years, as clinically indicated, further deep roentgen therapy was given. The chief indications were increased nasal obstruction, external appearances of tumor extensions in the right ethmoid and right infraorbital regions, together with x-ray evidence of further bony replacement. In later months there was extension to the left side to involve all sinuses, with replacement of and absorption of all bony structures of the paranasal sinuses. The course was one of repeated tumor extensions followed by deep roentgen therapy to the point where the tolerance of the patient's tissues limited the use of this therapeutic agent. X-ray examination on Jan. 17, 1955, was reported by Dr. Flora M. Brown, who stated: "There is a huge soft tumor mass involving the upper half of the face. This has displaced the nasal soft tissues markedly upward and the nasal alar cartilages laterally 3 to 4 cm. There is a fantastic destruction of the facial bones. The hard palate has completely disappeared. The walls of both

Fig. 1.—The nasal septum is filled with tumor tissue. Replacement of bone is demonstrated in the median wall of the right antrum and orbital rim. Date of picture, Dec. 2, 1952; age of patient, 79; weight, 160 lb.

Fig. 2.—There is now invasion of sinuses bilaterally, bony replacement in the hard palate, and aeration of the frontal sinuses only, even though their inferior bony walls are being replaced by tumor tissue. Date of picture, March 2, 1954; age of patient, 80; weight, 153 lb.

Fig. 3.—Final destruction of sinus walls except the superior portion of the anterior wall of the frontal sinuses. Involvement of the hard palate. Date of film, Jan. 17, 1955; age of patient, 81; weight, 93 lb.

maxillary sinuses are destroyed." There was no invasion of the skin and subcutaneous tissues. One perforation occurred late from stretching and pressure over the left ethmoid region. The patient died Jan. 26, 1955, aged 81.

Pathology Report.—When the brain was removed from the cranial cavity, it was found to be, on external examination, free from tumor. The anterior fossa of the base of the skull was markedly involved by a soft necrotic mass. This tumor mass had not penetrated the dura. On incision of this tumor mass it was found to be largely degenerated tissue. The tumor extended down into the orbital regions bilaterally and into the nose and completely involved the bony palate. The tumor had a grayish-white color, was soft in consistency, and was somewhat myxomatous. It was degenerated in its center. It extended to the sella turcica, but the sella turcica was free from tumor invasion. To summarize, the tumor had involved the nasal bones, the ethmoid, the maxillary bones bilaterally, and the anterior portion of the sphenoid bones. In consequence, there was one solid mass of tumor extending from just beneath the dura of the anterior fossa all the way to the roof of the mouth with osseous replacement through to the skin of the face, demonstrated easily by blunt dissection. In the gross summary of the pathology Dr. Balkin stated: "The chondrosarcoma of the nose with extension to the surrounding structures does not invade the dura or the skin. There is a well marked coronary sclerosis with myocardial scarring on the anterior and posterior walls of the left ventricle. There is a small aneurysmal dilatation beneath the posterior cusp of the mitral valve. Other findings are: confluent bronchial pneumonia of the right lower lobe, a recent poorly adherent embolus in the main branch of the pulmonary artery, hemorrhagic cystitis, fatty changes and passive congestion of the liver. There were no lung metastases. The causes of death are multiple."

Fig. 4. — Section of tumor demonstrating the increased cellularity of chondrosarcoma and the irregular nuclear patterns. Necropsy section.

Summary

A case is reported with necropsy findings of chondrosarcoma originating in the nasal septum and secondarily invading all paranasal sinuses with a known duration of 15 years. When compared with the durations found in other records, this duration would seem to indicate that with increasing age there is a corresponding decrease in rate of growth of the tumor.

According to Coley's classification, this is a secondary type of chondrosarcoma arising from a cartilage rest in the bony portion of the nasal septum, occurring typically in older persons, and not characterized by metastases.

This tumor is characterized by cartilaginous replacement of normal bone with subsequent myxomatous degeneration without invasion of soft tissues, such as skin and dura.

It is my opinion that the management outlined is preferable, in this instance, to the gross dysfunction and disfigurement resulting from extensive surgery. Radical surgery with the use of a prosthesis in this location and with this tumor has still a poor prognosis.

Methadone (Dolophine) hydrochloride was of superior value in controlling pain in the terminal stage.

Chondroma and chondrosarcoma are known to be resistant to irradiation. Expertly directed x-ray therapy is of considerable value in the management of chondrosarcoma to the extent of retarding and temporarily reducing marginal growth.

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Audiology Section

JOSEPH SATALOFF, ASSOCIATE EDITOR

An Audiologic and Otorhinologic Study of Cleft-Lip and Cleft-Palate Cases

II. Otorhinologic Evaluation

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In a previous article,[5] the audiologic results of this study were presented. It was reported that this population had mild to moderate conductive-type auditory impairment.

Although there has been no complete audiologic and otorhinologic evaluation of cleft-lip and cleft-palate cases prior to this study, the literature presents a number of ideas as to the basis of hearing loss in cleft-lip and cleft-palate persons. Generally, it is agreed that middle-ear pathology is the prime factor. However, there is less agreement as to the cause of the middle-ear pathology.

Openness of the palate, while discounted in one study,[4] is considered a potent factor in that spread of upper respiratory infections through the Eustachian tubes to the middle ear is facilitated by the open palate.

Dysfunction of the Eustachian tube has been suggested as another potential threat to hearing.* Aside from the role of the Eustachian tube in harboring and transmitting infectious material, deviations of the tube present a serious problem in three ways. Since one function of the Eustachian tube is to maintain a fairly close balance between atmospheric pressure and middle-ear pressure, an imbalance of the pressure ratio occurs in the instance of chronic tubal stenosis and, as has been shown experimentally, a decrease in auditory acuity follows. Secondly, marked chronic negative pressure in the middle ear, because of tubal obstruction, may reverse the osmotic pattern in the middle ear in that serum flows from the blood vessels to reduce the partial vacuum and to increase the pressure of the remainder of the air by reducing the volume the air occupies in the middle ear.[8] Chronic negative pressure, therefore, will promote fluid in the middle ear, reducing the efficiency of that part of the hearing mechanism by increasing the mass of the conducting components.[1] Also, blockage of the Eustachian tube may tend to inhibit its function as a drainage canal for the middle ear. It is obvious, therefore, that tubal stenosis can affect hearing in any or all of these ways.

Tubal stenosis is attributed mainly to repeated attacks of rhinopharyngitis and hyperplasia of the oropharyngeal lymphoid structures through blockage of the pharyngeal orifice of the Eustachian tube.[3] Changes in the fibers of the palatal muscles because of repeated inflammations, surgical damage, or atrophy may result in collapse of the muscular tissue at the tubal orifice.† Obstruction of the orifice may result from allergic swellings of tubal and pharyngeal mucosa, fibrous adhesions, and cicatricial tissue.[8]

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*Gannon, J.: A Study of the Effect of Certain Surgical Variables on the Auditory Acuity of 50 Cleft Palate Children, Unpublished Master's Thesis, University of Washington, 1950.

† References 1, 2, 6, and 7.

A study of the embryology of the palate, Eustachian tube, and middle ear offers one possibility of determining etiology. The morphological relationship between the primordia may mean that a disturbance in palatal development would have its concomitant effects in adjacent structures. The temporal relationship in development among these structures is close enough, so that it is conceivable that failure of the union of the palatal plates may be related to a process that would alter the growth of the Eustachian tube or the ear. Structural deviations in the Eustachian tube and middle ear could account for the occurrence of diseases and hearing loss in the cleft-lip and cleft-palate person. Any postulation about an embryologic relationship between the cleft palate and middle-ear involvement is necessarily limited by the lack of information in this area.

It has been postulated that a relationship might exist between observed anatomic and physiologic deviations and the presence of hearing loss in cleft-lip and cleft-palate persons. Amplification of this hypothesis suggested that the nature of the hearing loss might imply a relationship to the cleft-lip and cleft-palate condition or other possible deviations. These deviations might include the aural structures, Eustachian tubes, palate, pharynx, nasal structures, and predisposing infectious conditions. The need for both an audiologic and otorhinologic evaluation was therefore indicated. Careful otorhinologic studies were required for two purposes. It would be necessary to describe the condition of a number of structures, and then test the relationship of any deviation to hearing loss.

The following research questions were formulated:

1. What is the condition of the aural structures in cleft-lip and cleft-palate persons?

2. What conditions exist in the Eustachian tubes of the cleft-lip and cleft-palate persons that might be related to deficient hearing acuity?

3. What direct sources of infection exist in cleft-lip and cleft-palate persons that might be related to deficient hearing acuity?

4. What structural deviations exist in cleft-lip and cleft-palate persons that might be related to deficient hearing acuity?

5. Is openness of the palate in cleft-lip and cleft-palate persons related to deficient hearing acuity?

6. Is there a significant difference between groups in the combined frequency of structural and pathological threats to hearing?

7. Is there any relationship between familial history of hearing loss and deficient hearing acuity in cleft-lip and cleft-palate persons?

Procedure

Sixty-nine cleft-lip and cleft-palate persons were examined audiologically and otorhinologically. The otorhinologic examination consisted of evaluation of several areas and a number of structures.

The examination of the ears consisted of an evaluation of structural deviations in the external auditory meati and study of the middle ears for evidence of membrane scarring, middle-ear fluid, membrane perforations, and presence of middle-ear pathology.

In the examination of the nose, the septum and inferior turbinates were considered. Deviations of the septum and chronically oversized inferior turbinates were described. Examination of the tonsils and adenoid was also included, and the absence or presence of these structures was noted. When present, they were classified according to size. The health, adequacy, and tensity of the pharyngeal mucous membranes were also considered.

A twofold evaluation of the Eustachian tubes was made. The clinical evaluation included study of the peripheral tissue of the pharyngeal orifices for evidence of scarring as a result of palatal surgery. Then, too, the size of the Eustachian-tube orifices were evaluated. In order to obtain some understanding of the actual functioning of the Eustachian tubes, pneumophonic testing was included. The function of the pneumophone is based on the fact that a pressure differential between the middle ear and the external ear will reduce the transmission of the sound.[9] Consistent negative pressure in the middle ear is an indication of a constant degree of tubal stenosis. The pneumophone is designed to give the actual level of pressure in the middle ear by attempting to match it with a measured quantity of pressure ex-

ternally. When the external and internal pressures are equal, auditory acuity should be maximal. That the pneumophone does give the exact pressure readings has been validated.[8] Since the literature gives indefinite information on the supposed normal readings on the pneumophone, the test was standardized on 20 young adults with normal hearing and no history of ear pathology. A significant difference between the right and left ears was found, and no tenable explanation could be found for this difference. Consequently, the right and left ears of the cleft-lip and cleft-palate cases were evaluated separately according to the norms established with the standardization group.

To supplement the information obtained in the otorhinologic evaluation, each patient was given an oral examination in which degree of cleft was noted along with perforations or unoperated portions of the total cleft. The velopharyngeal musculature was also considered in that mobility of the soft palate and the lateral pharyngeal walls was measured. The distance from the posterior border of the soft palate to the posterior wall of the pharynx was also measured.

The concluding portion of the study of the person was the medical case history. The parent was questioned as to the child's history of earaches, running ears, mastoiditis, tonsillectomy and adenoidectomy, and upper respiratory infections. Inquiry into familial history of hearing loss was made. Information as to the number of palatal operations performed and the age of surgery was also gathered.

The otorhinologic evaluation, oral examination, and case history were so designed as to obtain as much data as possible on factors that might be related to hearing.

Results

Table 1A gives the frequency of structural and pathologic deviations for Group I (group with hearing loss) and Group II (group without hearing loss) and the significance of the difference between groups.

A significant difference between groups was found in the frequency of active middle-ear pathology, with the greater frequency in Group I. Similarly, Group I had a significantly greater number of cases with eardrum scarring. If eardrum scarring is considered evidence of past middle-ear pathology, it can be seen that middle-ear pathology was an important factor in relation to hearing loss in this population. No significant difference was found between groups in frequency of eardrum perforations, middle-ear fluid, or narrow external auditory meati.

Analysis of the data concerning the Eustachian tubes revealed that there was a significantly greater number of cases in Group I with small tubal orifices. Also,

TABLE 1A.—*Comparison of Structural and Pathologic Factors in Groups I and II*

Variables	Group I		Group II		P*
	Present	Absent	Present	Absent	
Active middle-ear pathology	11	26	0	32	0.004
Eardrum scarring	24	13	11	21	<0.05
Eardrum perforations	8	29	1	31	>0.92
Middle-ear fluid	4	33	3	29	†
Narrow external meati	3	34	2	30	†
Small tubal orifices	30	6	16	15	<0.02
Tubal scarring	0	37	0	32	†
Abnormal pneumophonic readings (right ear)	8	10	1	24	<0.01
Abnormal pneumophonic readings (left ear)	11	7	2	23	<0.01
Unhealthy pharyngeal mucosa	1	36	0	32	†
Inadequate pharyngeal mucosa	0	37	0	32	†
Tense pharyngeal mucosa	0	37	0	32	†
Oversized inferior turbinates	18	19	13	19	>0.05
Oversized inferior posterior turbinates	11	26	9	23	†
Septal deviations	23	14	23	9	>0.05
Adenoid pathology	27	10	17	15	>0.05
Tonsillar pathology	31	6	19	13	<0.05
Frequent and infrequent earaches	8	17	5	12	†
Frequent and infrequent running ears	3	12	1	8	†
Mastoiditis	1	36	1	31	†
Immobile soft palates	13	24	16	16	>0.05
Decreased pharyngeal mobility	23	14	20	11	†
Palatal perforations	6	31	10	22	>0.05
Complete clefts	23	14	19	13	†

*Probability was computed either by the direct probability formula or by the chi-square formula.
†Inspection of the differences between the theoretical frequencies and the observed frequencies showed that there was no significant difference between the groups.

Group I had a significantly greater frequency of abnormal pneumophonic readings. The data suggested that tubal stenosis plus middle-ear involvement played an important role in the hearing losses in these cases. No evidence of tubal scarring as the result of palatal surgery was found.

Although it was expected, there was no strong evidence to indicate that either group had unhealthy, inadequate, or tense pharyngeal mucous membrane.

Another unexpected result was the high frequency of oversized anterior and posterior aspects of the inferior turbinates. However, differences between the groups were not significant. Similarly, the difference between groups in the frequency of septal deviations was insignificant.

Although there appeared to be a relatively high frequency of adenoid pathology in Group I, there was no significant difference between groups. The difference in frequency of tonsillar pathology between groups was significant, and tonsillar pathology appeared related to hearing loss. The reported frequency of earaches, running ears, and mastoiditis did not differ significantly between groups.

No significant difference was found between the groups in the frequency of immobile soft palates or decreased pharyngeal mobility.

Openness of the palate, as evidenced by palatal perforations or complete clefts, was not a significant factor in that there was no significant difference between groups in the frequency of these variables.

Table 1B gives further data on structural, pathological, and surgical factors that were investigated in the study.

No significant difference was found between the groups in the age at first or last palatal operations or in the distance from the soft palate to the posterior pharyngeal wall. These results suggested that openness of the palate was not a contributing factor to the hearing loss in these cases.

Infectious threats to hearing as evidenced by the number of colds per year or the age at tonsillectomy and adenoidectomy did not appear to be significant variables.

When the frequencies of structural and pathologic deviations were combined for each group, it was found that there was a significant difference between the groups. It appeared, therefore, that different variables were operative in different cases in contributing to the incidence of hearing loss in this population.

Table 2 gives the frequency of upper respiratory infections in both groups. Statistical analysis of the data showed that there was no significant difference between Group I and Group II in the frequency of upper respiratory infections.

Table 3 gives the frequency of cases with familial histories of hearing loss. The lack of significant differences between the groups

TABLE 1B.—*Comparison of Structural, Pathological, and Surgical Variables in Groups I and II*

Variables	Group I			Group II			
	M	SD	SE_M	M	SD	SE_M	
Age at first palatal operation (in years)	1.87	2.24	0.44	1.86	2.61	0.52	0.02*
Age of last palatal operation (in years)	5.28	7.10	1.63	4.12	3.12	0.76	0.64*
Distance from soft palate to posterior pharyngeal wall (in centimeters)	1.39	0.60	0.10	1.52	0.44	0.08	1.03*
Number of palatal operations	3.27	2.31	0.43	2.93	1.98	0.38	0.59*
Number of colds per year	2.62	2.39	0.48	1.65	0.55	0.11	1.96*
Age at tonsillectomy and adenoidectomy (in years)	6.50	3.08	0.60	6.81	2.69	0.70	0.34*
Combined number of structural and pathologic deviations	5.95	1.64	0.27	4.75	1.73	0.31	2.89†

*Not significant.
†Significant at the 1% level of confidence.

TABLE 2.—*Frequency of Upper Respiratory Infections in Groups I and II*

Infections	Group I	Group II
Measles	30	22
Rubella	12	13
Chicken pox	23	24
Whooping cough	14	10
Mumps	10	12
Scarlet fever	3	5
Other diseases	7	3

Chi square is 3.954, not significant.

suggested that the possibility of congenital hearing problems was not a factor in this population.

TABLE 3.—*Frequency of Cases with Familial Histories of Hearing Loss*

	Group I	Group II
Familial hearing loss	12	6
No familial hearing loss	24	25

Chi square is 1.021, not significant.

Summary

Evidence to substantiate the idea that middle-ear pathology was the basis for hearing loss in this population of cleft-lip and cleft-palate persons was found in the significant number of cases with active middle-ear pathology and eardrum scarring.

It was also found that abnormal tubal patency and small Eustachian-tube orifices were related to hearing loss. Exactly what this relationship was is unknown, but the otologic literature describes conditions in which tubal dysfunction can lead to middle-ear pathology because of inadequate drainage and ventilation of the middle ears.

The only direct source of infection found to be related to hearing loss was tonsillar pathology. The nature of this relationship is not known, and it can only be assumed that the infected tonsils perhaps furnished the nidus for the middle-ear inflammation, and then the Eustachian-tube dysfunction tended to perpetuate the inflammation.

The following variables did not appear to be related independently to hearing loss: eardrum perforations, middle-ear fluid, narrow external meati, adenoid pathology, oversized inferior turbinates, septal deviations, decreased soft palate mobility, decreased lateral pharyngeal wall mobility, palatal perforations, degree of cleft, frequency of earaches, frequency of running ears, reported frequency of colds, reported frequency of upper respiratory infections, age at tonsillectomy and adenoidectomy, age at first palatal operation, and familial history of hearing loss.

The significance of the combined frequency of structural and pathologic deviations, which included a number of variables that were insignificant when tested independently, suggested that all the variables contributed to hearing loss and that different variables may have been effective in particular cases.

In the light of the fact that middle-ear pathology was the outstanding factor in the hearing losses of this population, it can be speculated that hearing losses can be prevented in cleft-lip and cleft-palate persons. Chronic middle-ear pathology in a number of cases would indicate that hearing losses might also be progressive if otologic treatment were not applied. However, the fact that other deviations in combination were related to hearing loss would mean that otologic care alone might not be able to prevent entirely the onset or continuance of middle-ear pathology.

The prevention of hearing loss in cleft-lip and cleft-palate cases should be a major aspect of a habilitation program. Adequate attention to the problem would indicate the need for parental counselling and otorhinologic examination supplemented by regular tubal and ear examinations by the pediatrician. With the advent of any otologic syndrome, referral should be made to an otologist. Hearing acuity should be checked as early as possible, and it should be rechecked routinely because of the threat that exists for cleft-lip and cleft-palate cases.

Since the only foci of infection positively related to hearing loss were the tonsils, their removal in the event of recurrent infection should be considered. The importance of the tonsils to speech production is much less than the importance of ensuring adequate auditory acuity for speech perception. While adenoid pathology alone was not related to hearing loss, it was one variable in the combined threats that were related to hearing loss. Since the pathologic threat to speech perception through retention of the adenoid is greater than the mechanical threat to speech production through adenoidectomy, it may be advisable to remove infected adenoids in all cleft-lip and cleft-palate persons.

While the nature of the Eustachian-tube disturbances was not fully established, surgical treatment of the cleft soft palate should be so handled as to insure against damage to the tubal orifices and their musculature. Analysis of the results indicates, too, that early closure of the cleft palate will not preclude the possibility of middle-ear pathology and hearing loss. However, since palatal perforations were included in the combined threats to hearing that were related to hearing loss, it would be advisable to plan prosthesis for closure until such time as surgical closure takes place.

It can be seen that plans for the total habilitation of cleft-lip and cleft-palate cases must expand measurably to allow for consideration of the audiologic-otologic problems that may be present. An adequate team in this work should include the services of an otologist, in order to give cleft-lip and cleft-palate cases much needed medical care. There is a need for all members of the cleft-palate team to have a broader understanding of the importance of the hearing problems and the relationship of these problems to other areas in cleft-lip and cleft-palate treatment.

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Trends in Education of the Deaf

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Introduction

The modern and advanced concept of an educational program for the more severely aurally handicapped undoubtedly demands that it shall include all age brackets. The program must provide a continuous and complete structure which begins at the very earliest years with those influences and training methods that are found in the home. Later, of course, this will be expanded to include such educational experiences at the school or academic level as are possible until the child is placed under direct, full-time professional instruction. This plan, beginning at the earliest home level and proceeding logically to the academic level, may be regarded as the ideal approach in the various and multiple educational cycles for the aurally handicapped.

Unfortunately, in the past few years, while there has been a strong tendency to direct considerable attention to the 4- to 6-year-old age bracket, not enough serious thought has been given to the formative years prior to this particular age level. At the same time some educators have not kept in proper prospective the also equally important years which immediately follow the so-called "preschool" group. Consideration must be given to the fact that the pupil cannot be merely placed entirely according to his "age" group in school but, to obtain full benefit, the pupil must be placed in the class or group which is best fitted to his individual experience and training. It is apparent that training for the more severely handicapped boy or girl must have a long-range program, and it is never too early to give serious consideration to this problem from the first moment that deafness is diagnosed. Thought must be given to the child's future 5 and 10 years and onward to the period of maturity, when he is ready to take his normal place in a society as a self-sustaining, socially acceptable citizen.

When one gives equal consideration to the total aspects of a complete educational program, one recognizes that it is complex and cannot be planned adequately and logically on a day-to-day basis. The progress and the rate of growth for the deaf, as for the normal hearing, is entirely individualistic, and there cannot be a definite set of rules that will suffice for all. True, certain set educational concepts apply for all persons, be they deaf or of normal hearing, but the aurally handicapped requires a well-planned educational program that is geared to his particular needs.

Formal Education in the Home

One of the initial moves in the education of the deaf is an early start in the right direction. Teachers and administrators of the deaf are well aware that one of the worst tragedies to befall the aurally handicapped is for this child to be enrolled in a school for the deaf at the age of 8 or 9 after literally "sitting" at home without the benefits of early home and academic training.

When the formal education of the severely hearing handicapped is delayed until 8 or 9 years of age, several vitally important years have been wasted, and this delay, so far as academic learning is concerned, is almost irreversible. The majority of 8- or 9-year-old deaf students have been in school since the age of 4 (even younger in some schools), and prior to entering a school some may have received private instruction at

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home; others may have gone to a private clinic or a day nursery school. The children who begin earlier to learn the basic concepts of lipreading and the basic elements of speech have an advantage over those who begin this same training when they are 8 or 9 years of age. Children entering a normal hearing school are grouped for classroom purposes by their chronological age, and the same applies, in a limited sense, for children entering schools for the deaf excepting those entering later than the sixth year without previous training. Administrators in schools for the deaf attempt to group 4- to 5-year-olds in one group; 6- to 7-year-olds in another group, etc. In the proper planning, school administrators must give consideration to several variables other than just chronological age. Thought must be given to the student's physical size, the degree of hearing loss, the intelligence of the student, and his ability to handle lipreading, speech, and language. When a deaf student's education is delayed until he is older it is difficult, if not an almost impossible task, for a school administrator to place a youngster in the proper classroom where all his individual needs can be met adequately.

Usually, when a small child first enters a school for the deaf he will spend the first year in a nursery group, and the following school year will be spent in a kindergarten. The educational trends for both groups are somewhat similar to those of a public hearing school except special emphasis is given to the beginning fundamentals of lipreading and speech; the student's work for the third year is of a more formal nature, for here is the beginning of limited preprimer reading, learning the simple forms of writing, etc. During this three-year period considerable attention has been directed toward auditory training, lipreading, and speech but far more important is the training that enables him to learn to live and play with others and to accept the give-and-take that we all experience in any group situation.

The Need for Earlier Diagnostic and Remedial Attention

In recent years, there has been a steadily growing demand for an earlier differential diagnosis of a child suspected of having defective hearing. At one time, when tradition and faith were stronger than logic, parents held firmly to the belief "my child is still too young to be examined and all we can do is wait until he is older." In some situations, parents were professionally advised "in due time your child will outgrow this problem—wait and see what happens." In the past few years, with a closer working relationship of educators and physicians, there has been a decided trend in the revision of past philosophies. Now, each profession is cognizant of the physical, educational, and psychological ramifications of deafness, and each recognizes the dire need for an early and a complete diagnosis with a follow-up of early remedial measures.

Several years ago, it was extremely difficult, if not almost impossible, to obtain an accurate, reliable diagnosis with the very young child. This was especially true when the diagnosis was limited to the use of tuning forks, the use of noise makers, and the watch-tick, voice, and whisper tests. The advent of electronics brought forth a new battery of diagnostic tools that has provided the means for a more accurate and reliable diagnosis. The use of pure-tone audiometry and psychogalvanic skin resistance testing and the employment of speech reception threshold studies, combined with the previously mentioned clinical tools, have enabled the diagnostician to obtain, for the majority, a more complete and reliable diagnosis at an earlier age level.

The audiological and otological diagnosis does not complete the total study of the person. Included in this early survey should be a complete and thorough pediatric examination. Deafness in itself is a large problem; but when it is complicated by additional physical anomalies, the educational task can become much greater. Teach-

ers of deaf children have found that an ophthalmological examination has extreme value because for the deaf child the eyes become, literally, their ears. To help round out this diagnostic picture there should be a complete psychological examination which would furnish the classroom teacher with an idea of the intellectual potential.

Regardless of the completeness of the diagnosis, it is superfluous when it is not followed by careful therapeutic measures—be they of a physical, psychological, academic, or mechanical nature. The program cannot be considered complete until parent, physician, and educator share in their combined abilities for the guardianship of the deaf student. This requires a team approach —it cannot be adequately handled alone.

Sources of Help

In far too many instances there is a tendency for parents to waste valuable time because they lack the knowledge of where to turn for help. The child's early formative years may not be properly developed because parents may not be aware of the severity of the handicap and the multiple ramifications connected with this handicap, and they lack the knowledge of a systemic methodology to cope with the problem. The small deaf child is a strong-willed, at times an almost uncontrollably determined youngster. Many times, parents state, "I can't handle him. I don't know what to do with him." The adjustment problems that face this particular youngster by the time he enters a school for the deaf are almost manifold. If parents had availed themselves of help during these trying years, the psychological ramifications would not be so great and the academic progress may have been accelerated.

Several nonprofit organizations offer a wealth of excellent information for the lay and the professional person. A list of these organizations is appended at the close of this article for the use of any reader who may wish to make use of one or more of them.

The Incidents of Total Deafness

Many times one will hear the remark, "That child is totally deaf." However, incidence of total deafness is rare. This is pointed up very clearly in an evaluation of pure-tone audiometrics done at The Pennsylvania School for the Deaf in 1955-1956. The following statistics were obtained from 479 different subjects ranging from 4 to 20 years of age. Each of the students was administered at least three pure-tone threshold studies, and the majority had received numerous studies in past years.

The individual audiometric tests were conducted in a sound-proof room with a Maico F-1 and/or a Maico MA1 audiometer. The subject was seated in a chair beside but a little behind the audiometer. The subject was placed such that he was not in a position to see the controls during the time of the test. The tester was seated in such a manner that he could observe the subject's face.

The following frequencies were presented: 125, 250, 500, 1000, 2000, 4000, and 8000. However, for the purpose of our study, only the frequencies of 500, 1000, 2000, and 4000 were evaluated.

Where possible, the subject was asked to raise his hand when the tone was presented and to lower his hand when the tone was no longer audible. With many of the very young children the subject was conditioned by having him drop a tongue blade in a jar when he heard a tone, or a peg board was used and the subject inserted a colored peg in the board when the tone was audible. The patient's signal button of the audiometer was not used because it was felt that it involved a certain amount of coordination and conditioning reflexes which might detract from the student's ability to listen critically.

A subject with a 20 to 65 db. loss of hearing (for the better ear) was classified as hard of hearing, and a subject with a 65 to 100 db. loss of hearing was classified as deaf.

An evaluation of 479 different subjects indicated the following:

Males: test not accurate	19	
Females: test not accurate	16	
		35
Males: could not be tested by pure-tone audiometry	6	
Females: could not be tested by pure-tone audiometry	5	
		11
Hard of hearing males	55	
Hard of hearing females	34	
		89
Deaf males	177	
Deaf females	163	
		340
Totally deaf males	1	
Totally deaf females	1	
		2
Grand total		479

Conclusions: The 35 students listed as "test not accurate" were made up, in part, by the preschool group and the students with multiple anomalies, such as cerebral palsy, aphasia, brain damage, etc.

The 11 students listed as "could not be tested by pure-tone audiometry" were all from the entering preschool group and are too young or immature for accurate pure-tone audiometry. The majority of this group had had a psychogalvanic study, but the results of these studies were not considered in the present evaluation.

It was extremely interesting to note that, out of 433 subjects, only 2 students gave a clinical indication of having a total and complete loss of hearing for all frequencies from 125 through to 8000 cps. One student (a female) had severe meningitis at the age of 2 years, and the other student (a male) contracted severe virus infection, possibly of encephalic type, at the age of 8 years and was left totally deaf.

This study points up very factually that the incidence of total deafness is extremely small. True, functionally speaking, without the use of amplification and proper teaching techniques, the majority of students in this study are profoundly deaf, but, clinically speaking, they do not fall in the category of totally deaf.

As a final conclusion, one cannot think of deafness as an absolute because there is too much of a variable present. From an audiologist's point of thinking, we are extremely interested not in the deafness but in hearing. We must concentrate more attention on the remaining residual hearing than in discovering how little hearing the student may have.

Methods of Instruction

After the diagnosis is completed begins the period when a decision must be made concerning informal and the eventual formal education. There are a multiplicity of facts and reasons to be evaluated before a determination can be made. It must be decided whether he is going to a residential school for the deaf, a normal hearing school, or a day school for the deaf. Many factors have to be taken into consideration before this decision can be made. An issue as great as this cannot be determined solely on the basis of a specific decibel loss. True, the amount of hearing loss will be some guide to educational placement, but, to a great extent, educational placement must depend on available local facilities, the individual needs of the child, and his physical growth and language progress made throughout his early formative years.

In recent years, there has been a strong trend to place handicapped children with nonhandicapped children. There are many incidents where parents do not fully realize the enormity of the academic, social, and growth problems confronting a deaf child and they run the risk of putting their child in a hearing class which is not correlated with his proper place in his total educational program. The placing of a handicapped child with normal hearing children has its pros and cons, but, unfortunately, far too many parents are mislead by their desperate desire to keep the family intact. There can be no exact and fast set of rules to decide whether the child is to be educated with the hearing or the nonhearing groups. The degree of hearing loss is not the only

criterion governing whether a student is to be educated in a residential deaf school, a day school for the deaf, or a regular classroom composed of normal hearing children. Each student requires and is entitled to an individual evaluation. There must be flexibility in this decision because a child may be placed in one situation and later transferred to another.

The parents will need to investigate the available local facilities and to decide whether these resources are adequate to meet their child's needs. At the same time, parents will have to decide the child's immediate educational, social, and psychological needs and also give serious thought to his needs for the future. The degree and type of hearing loss and the accompanying lipreading, speech, and language involvement will help to govern to some extent whether the child is to be "tutored" in these forms of communication while attending a regular hearing school or if he is to be "taught" these same subjects in a school for the deaf. Only expert examination can determine this.

If the child goes to a hearing school, it must be decided whether or not the school is able to handle the total problem. Will the child be "welcomed" by the administrative personnel, the teachers, and the students? Does the teacher understand the problem? Is the class so large the teacher can give no time to him for individual work? Will he be able to "keep up with the work," or will they just "pass" him?

The entire question of instruction methods narrows down to the fact that the future educational needs of the auricularly handicapped youngster rest greatly with the parents and the attending physician. In the broad sense, the child's complete future rests upon the decision made by these persons, and it is hoped these decisions are executed in the best interests of the child.

Appended

The Volta Bureau is operated as a nonprofit educational organization and is located at 1537 35th St., N. W., Washington 7, D. C. The Volta Bureau has many services for parents of deaf and hard of hearing children, including a free information kit, a parent's lending library, inexpensive books and pamphlets, etc. Individual letters are also answered by members of the Volta Bureau staff. The monthly magazine, *The Volta Review*, contains many helpful articles and a special column for parents. Dr. Alexander Graham Bell, a teacher of the deaf, founded and endowed the Volta Bureau in order to answer the many letters and requests for help received daily.

John Tracy Clinic, 806 W. Adams Blvd., Los Angeles 7, provides training for preschool deaf and hard of hearing children and their parents. There is an experimental nursery school to which mother and child are admitted as a unit; there are classes for parents conducted by the clinic staff; there is a consultation service, offering hearing and psychological tests for the children and counselling for the parents. The teacher-training department offers a training course for teachers of the deaf, leading to a degree from the University of Southern California.

The Tracy Clinic distributes a correspondence course for parents of preschool deaf children. The course, which is sent free to any parent of a preschool deaf child anywhere in the world, covers one year of work that the mother can do at home. The lessons are mailed in monthly installments, and the parents are expected to write monthly reports, to which they receive personal replies. The course is offered in English and Spanish. Translations in other languages are available in several European countries.

Founded in 1919, the American Hearing Society, 817 14th St., N. W., Washington 5, D. C., is the only nonprofit, national organization (with chapters) in the United States whose entire resources are dedicated to serving hard of hearing children and adults.

Helpful information on all phases of hearing problems may be obtained from the Society's headquarters. Chapters are located in 32 states, the District of Columbia, and Canada. Their services include some or all of the following: scientific hearing tests, lipreading instruction, speech correction, auditory training, advice on hearing aids, employment guidance, and recreational activities.

The American Hearing Society publishes *Hearing News* and distributes pamphlets, posters, and reprinted articles relating to hearing. President of the Society is Herschel W. Nisonger. Crayton Walker is Executive Director.

The Pennsylvania School for the Deaf.

Case Reports

ACUTE LEUKEMIA PRESENTING AS ACUTE OTITIS MEDIA

MOSHE FEINMESSER, M.D., Jerusalem

THE INITIAL symptoms of acute leukemia are often those of a severe infection, with high fever, malaise, headache, and prostration. Acute upper respiratory infection or acute tonsillitis is frequently diagnosed in the beginning of the disease.

The present case presented as acute otitis media with mastoiditis complicated by sinus thrombosis, the leukemia being diagnosed only at autopsy.

Report of Case

A boy of 11 was first seen in the outpatient clinic complaining of left earache which had started 17 days earlier with general malaise; 10 days after onset his face suddenly became asymmetric. During this time there was no discharge from the ear, the temperature was not taken, and the patient continued to be ambulatory. Otoscopic examination revealed acute left otitis media with a red bulging drum and tenderness on palpation over the left mastoid area. Signs of peripheral facial palsy were evident on the left. A left myringotomy was immediately performed, but only scanty serosanguineous discharge appeared. The boy was hospitalized. On admission the temperature was normal and the patient conscious and cooperative. The general physical and neurological examinations did not reveal any abnormal findings other than the facial palsy. The blood cell count was 4,670,000 red blood cells with a hemoglobin content of 12 gm/100 cc. and 6600 white blood cells with lymphocytosis. Blood urea and sugar were normal, as was the urine. X-rays showed both mastoids not well pneumatized, with haziness of cell system on the left but no evidence of bone destruction. Penicillin and chlortetracycline (Aureomycin) were prescribed. On the fourth day of hospitalization the temperature rose to 100.8 F and the tenderness over the mastoid increased. A left mastoidectomy was then performed, which revealed small cells filled with serosanguineous fluid and evidence of periphlebitis of the lateral sinus. After the operation a septic fever appeared and the general condition of the patient deteriorated. Blood examination showed severe anemia (Hb., 8 gm/100 cc.; r. b. c., 3,500,000 and a leucopenia (4000 leucocytes), no abnormality of cells being reported; a blood transfusion was given. Neurological examination then disclosed signs of mild meningeal irritation, and a spinal puncture was performed. The spinal fluid was clear with normal pressure, cell-count and chemistry and was sterile on culture. Suspicion of sinus thrombosis was aroused and a second mastoid operation performed. The sinus was exposed from the sinodural angle to the jugular bulb, an obturating thrombus was found and removed, and the internal jugular vein ligated. Fever of septic character continued; the patient was apathetic and very pale and complained of severe headache. Hepatosplenomegaly was found for the first time, on the 16th day of hospitalization, and the peripheral blood picture disclosed increasing anemia (Hb., 5 gm/100 cc.; r. b. c., 1,650,000). Blood cultures and Widal were negative; malarial and other parasites were absent. When, 11 days later, the ophthalmoscopic examination revealed blurring of the margins of both disks, a suspicion of cerebral abscess formation was aroused. Thirty-four days after his admission to hospital the patient suddenly lost consciousness and developed right-sided hemiplegia. Bilateral choked disk was found with blood extravasations. Ventriculography disclosed normal air filling of the ventricular system. The boy died the same night.

Postmortem examination revealed stem-cell leukemia involving the liver, spleen, kidneys, pancreas, heart, right adrenal, stomach, and vertebral bodies (Figs. 1 and 2); a recent diffused subdural hemorrhage above the right hemisphere; scattered areas of subdural hemorrhage above the left hemisphere, and scattered hemorrhagic foci in both capsulae internae and thalami.

Retrospectively, the suspicion of leukemia should have been aroused when severe anemia, which persisted despite transfusions, and hepatosplenomegaly were revealed. At the time they were thought to be due to the severe septic state.

Accepted for publication April 23, 1956.

From the Ear, Nose and Throat Department, Rothschild-Hadassah-University Hospital.

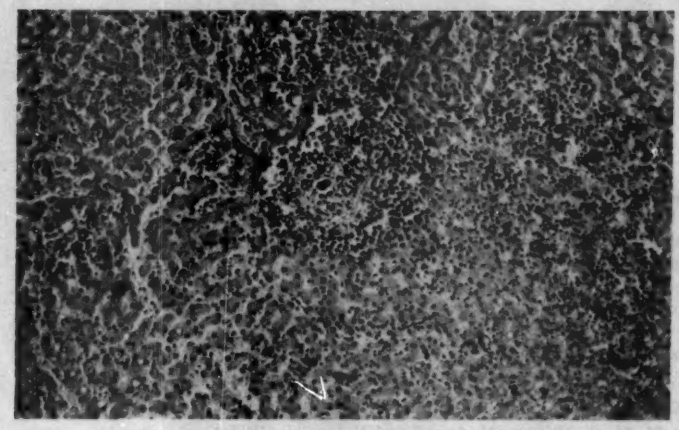

Fig. 1.—Liver: Patchy leukemic infiltration of portal spaces and sinusoids (hematoxylin and eosin stain; reduced slightly from mag. × 100).

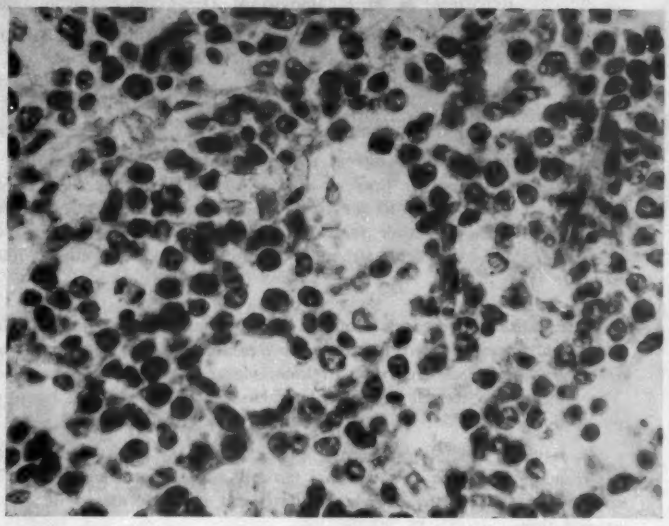

Fig. 2. — Vertebral body: Complete replacement of bone marrow by leukemic cells (hematoxylin and eosin stain; reduced slightly from mag. × 580).

Summary

A case of acute stem-cell leukemia is described, which presented as acute otitis media and mastoiditis complicated by facial palsy and sinus thrombosis. Signs which aroused suspicion of brain abscess proved to be due to hemorrhage into the brain.

The Department of Pathology supplied the report of the autopsy findings and the photomicrographs.

News and Comment

ANNOUNCEMENTS

Forty-Fourth French Congress of Oto-Rhino-Laryngology.—The Forty-Fourth French Congress of Oto-Rhino-Laryngology will take place from Oct. 15 to 18, 1956, in the Grand Amphitheatre of the Faculty of Medicine of Paris, under the presidency of Prof. Leon Binet, member of the Institute and Dean of the Paris Faculty of Medicine.

Numerous papers will be presented, and two particularly interesting reports will be discussed:

(1) Functional Plastic and Repair Surgery of the Nose and Sinuses.
Reporters: M. M. Aubry (Paris) and J. Ch. Giraud (Algiers).

(2) Postanginal Nephritis and Rheumatism—Pathological and Clinical Study.
Reporters: M. M. R. Maduro, M. Derot, and F. Layani (Paris).

An exhibition of surgical instruments, of fittings and of otorhinolaryngological specialities will be held in the Hall of the Faculty.

For all information, write to the administrative secretary, M. Raimond, 17, rue de Buci, Paris. Telephone Danton 55-24.

Sixth International Congress of Otolaryngology.—The deadline for submitting titles of papers and films for presentation at the Sixth International Congress of Otolaryngology is Oct. 1, 1956. Requests for places on the scientific program must be received before that date, together with an 800-word abstract of the paper. Applications and abstracts should be sent air mail to the General Secretary, 700 N. Michigan Ave., Chicago 11.

International Research Council.—Hamilton Cameron, M.D., New York, announces the recently incorporated International Research Council, the first world-wide medical confraternity for the dissemination of knowledge concerning aphasias associated with hemiplegia. The aims of the council include the establishment of a clearing house on the subject and the publication of a monthly *Review-Bulletin.*

In January, 1943, Dr. Cameron became one of the 600,000 hemiplegia aphasics. He devised a "Hand Talking Chart," that has proved a practical clinical aid. This has been a boon to those vocally paralyzed who hitherto had no such means of communication with those around them.

Dr. Cameron for eight years has been supplying the Chart to physicians and nurses with no charge, by the kind cooperation of the medical editors and editors of nonmedical publications.

For gratis copies of the chart and the detail information of the nature and aims of the International Research Council, address Dr. Hamilton Cameron, General Director, 601 West 110th St., New York 25.

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society

(Société Canadienne d'Otolaryngologie)

President: Dr. D. S. Gorrell, 110 Medical Arts Building, Calgary, Alta.
Secretary: Dr. G. Arnold Henry, 328 Medical Arts Building, Toronto.

International Bronchoesophagological Society

President: Dr. Antonio da Costa Quinta, Lisbon, Portugal.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fourth International Congress of Bronchoesophagology.
President of Congress: Dr. Antonio Carrascosa.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Netherlands.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

Sixth International Congress of Otolaryngology

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. John R. Lindsay, Chicago.
Secretary: Dr. Hugh A. Kuhn, 112 Rimbach St., Hammond, Ind.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave., Bldg., Rochester, Minn.

American Board of Otolaryngology

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.

American Broncho-Esophagological Association

President: Dr. Clarence W. Engler, 2323 Prospect Ave., Cleveland.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.
Place: Mark Hopkins Hotel, San Francisco. Time: May 21-23, 1958 (afternoons only).

American Laryngological Association

President: Dr. LeRoy A. Schall, 243 Charles St., Boston 14.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.
Place: Statler Hotel, Washington, D. C. Time: May 3, 1957.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Percy E. Ireland, 100 College St., Toronto, Canada.
Secretary: Dr. C. Stewart Nash, 700 Medical Arts Bldg., Rochester 7, N. Y.
Place: Mark Hopkins Hotel, San Francisco. Time: May 21-23, 1958.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

SECTIONS:

Eastern.—Chairman: Dr. Joseph Sullivan, Toronto, Canada.
Place: Royal York Hotel, Toronto, Canada. Time: Jan. 31-Feb. 1, 1957.
Southern.—Chairman: Dr. Mercer G. Lynch, New Orleans.
Place: Roosevelt Hotel, New Orleans. Time: Jan. 16-17, 1957.
Middle.—Chairman: Dr. Paul M. Moore, Cleveland.
Place: Hotel Cleveland, Cleveland. Time: Jan. 9-10, 1957.
Western.—Chairman: Dr. Sigurd v. Christierson, San Francisco.
Place: Hotel St. Francis, San Francisco. Time: Jan. 19-20, 1957.

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. John R. Lindsay, 950 E. 59th St., Chicago 37.
Secretary-Treasurer: Dr. Dean M. Lierle, State University of Iowa, Iowa City.
Place: Statler Hotel, Washington, D. C. Time: May 4, 1957.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

President: Dr. Joseph Gilbert.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

President: Dr. Dean McAllister Lierle, University Hospital, Iowa City.
Secretary-Treasurer: Dr. Michael H. Barone, 468 Delaware Ave., Buffalo 2.
Place: Palmer House, Chicago.

SOCIETY OF MILITARY OTOLARYNGOLOGISTS

President: Col. Wendell A. Weller
Secretary-Treasurer: Major Stanley H. Bear, M. C., 3810th USAF Hospital, Maxwell AFB, Ala.
Place: Palmer House, Chicago. Time: Oct. 16, 1956.

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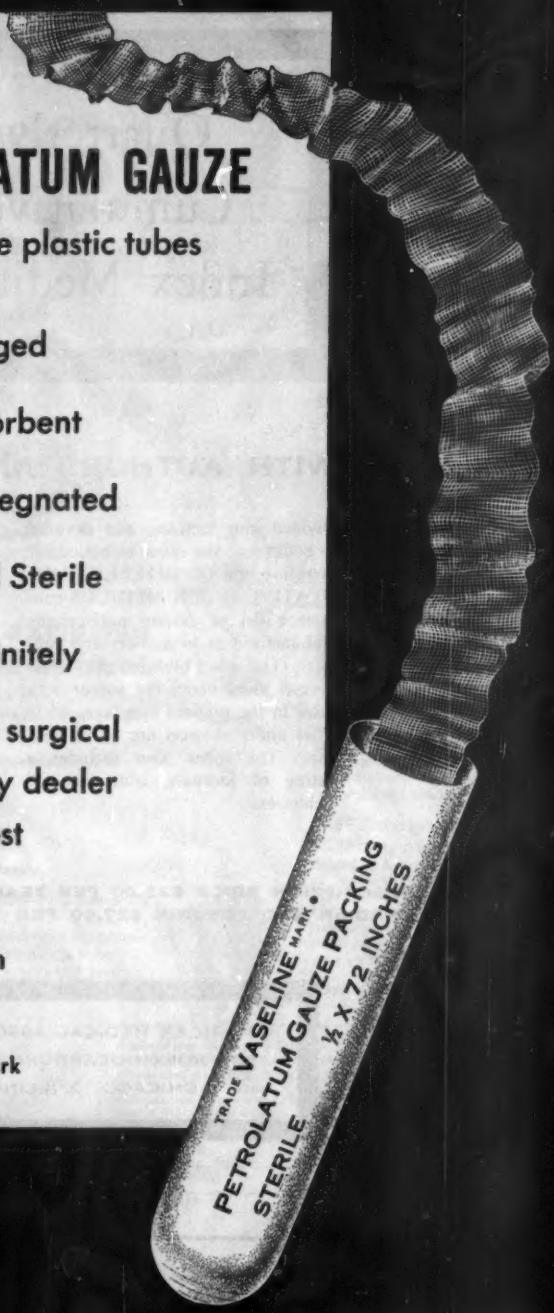

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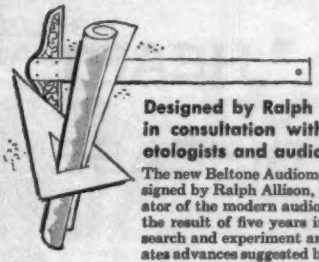

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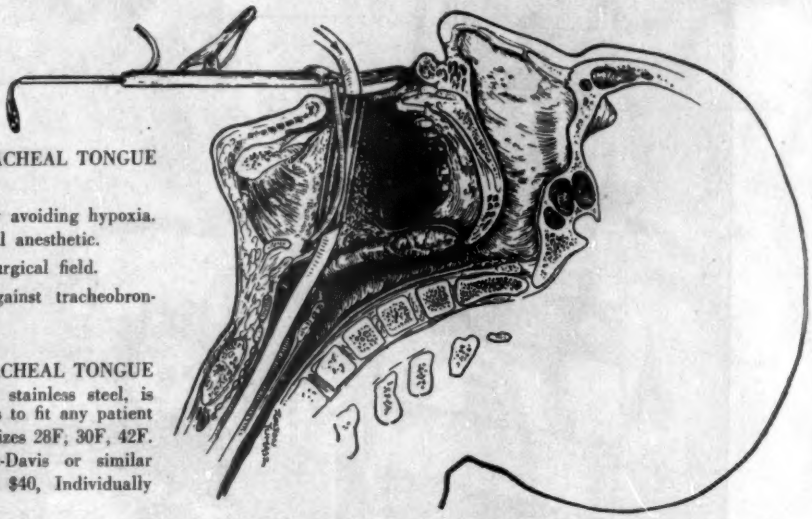

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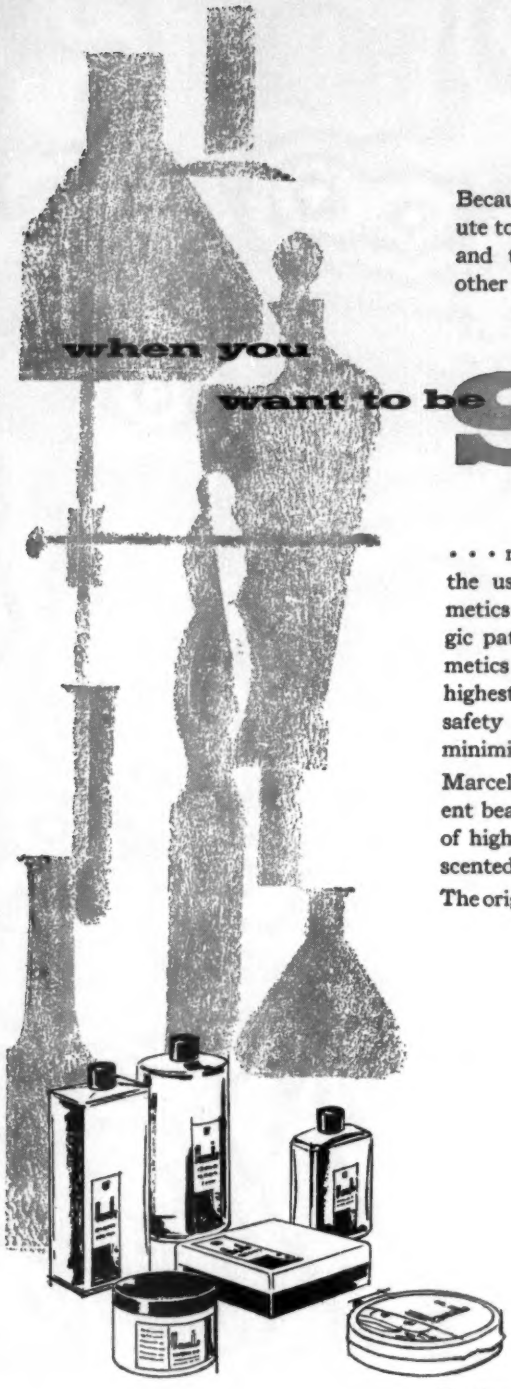

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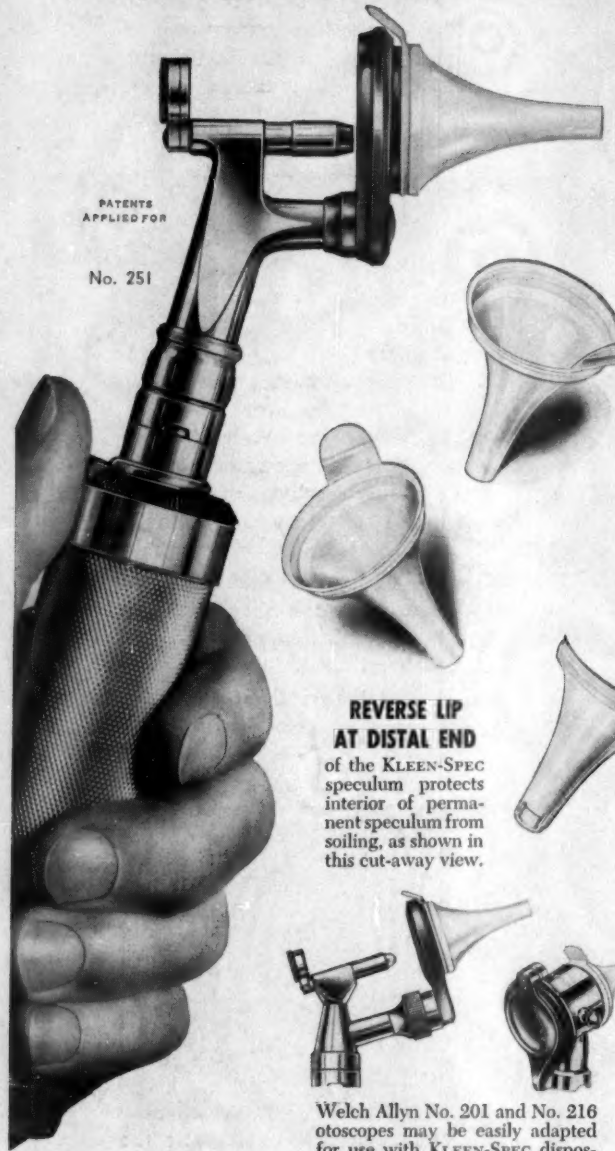

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